Power Engineering

Annual Review and Forecast

JANUARY, 1953

Volume 57, No. 1 Circulation of this issue 27,482

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Bigger, Better Power Plants 70

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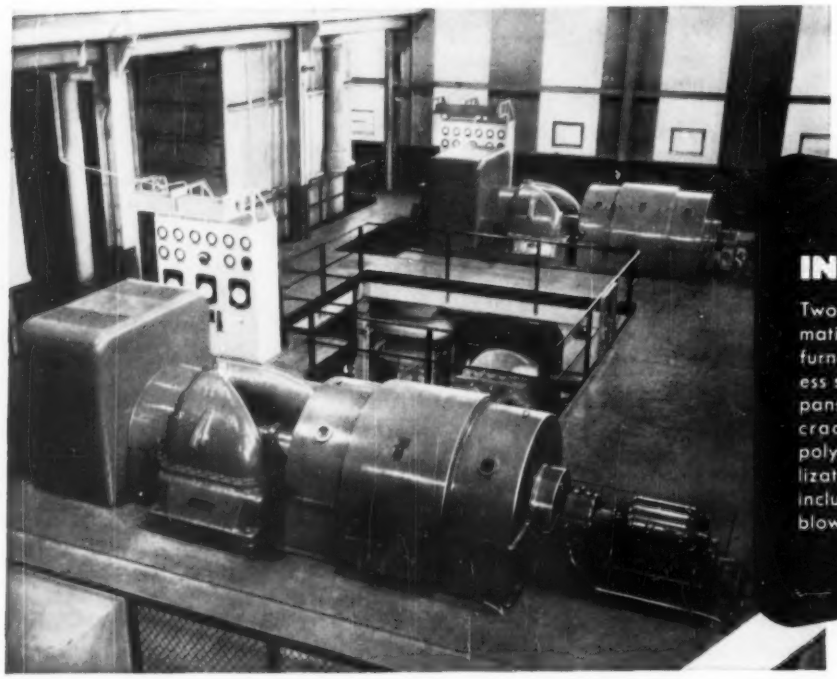
Meeting Industry's



IN AN OIL REFINERY

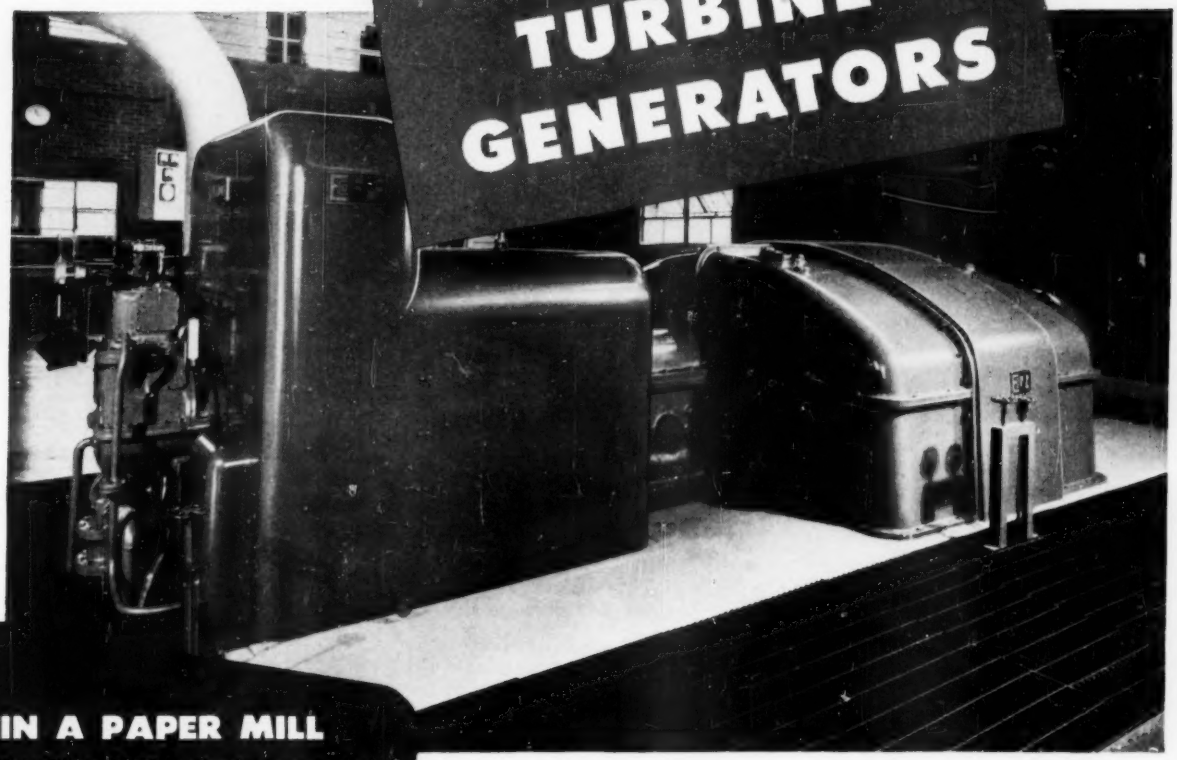
Two Elliott 4000-kw condensing, automatic-extraction turbine-generator units furnish the power and much of the process steam required by a tremendous expansion program involving a big cat cracker and new crude, distillation, polymerization, gas recovery and stabilization units. Other Elliott equipment included in the project: turbine-driven blowers, condensers, etc.

IN A PULP MILL

Two Elliott 2000-kw back pressure, automatic-extraction type turbine-generators were installed to provide power in a modernization program. To handle sudden electrical peak loads caused by modern log barkers and chippers, these turbines have sensitive and stable speed control, at the same time maintaining pressure control for the process steam load. This company has since bought two Elliott 3500-kw noncondensing turbine-generators for another mill.

varying power needs

ELLIOTT TURBINE-GENERATORS



IN A PAPER MILL

This Elliott 2000-kw back-pressure turbine-generator is the first step in a new power generating program. It now runs in parallel with outside power, which maintains frequency and takes the electrical load swings. Future expansion calls for a duplicate generator driven by a condensing, extraction-type turbine, giving a flexible power and process steam combination in the power plant.

Producing economical power, as a by-product of process steam is the job of a properly applied turbine-generator in an industrial power plant. Elliott engineers will help you work out a type or combination of generating units which will fit the electrical and steam needs of your plant. You'll be proud of your Elliott turbine-generator's operating record.

ELLIOTT Company

Steam Turbine Dept.
JEANNETTE, PA.

Plants at: JEANNETTE, PA. • RIDGWAY, PA.
AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.
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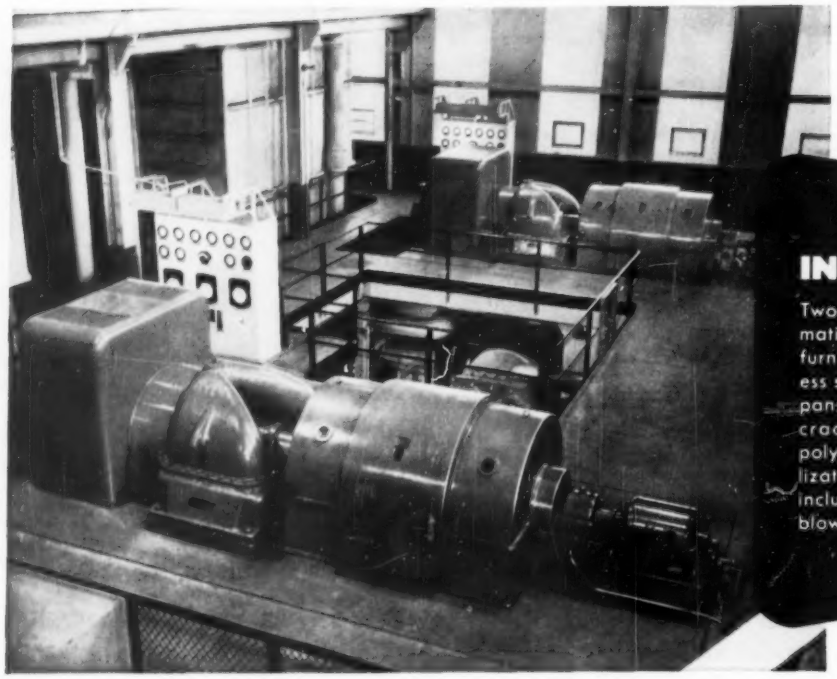
Meeting Industry's



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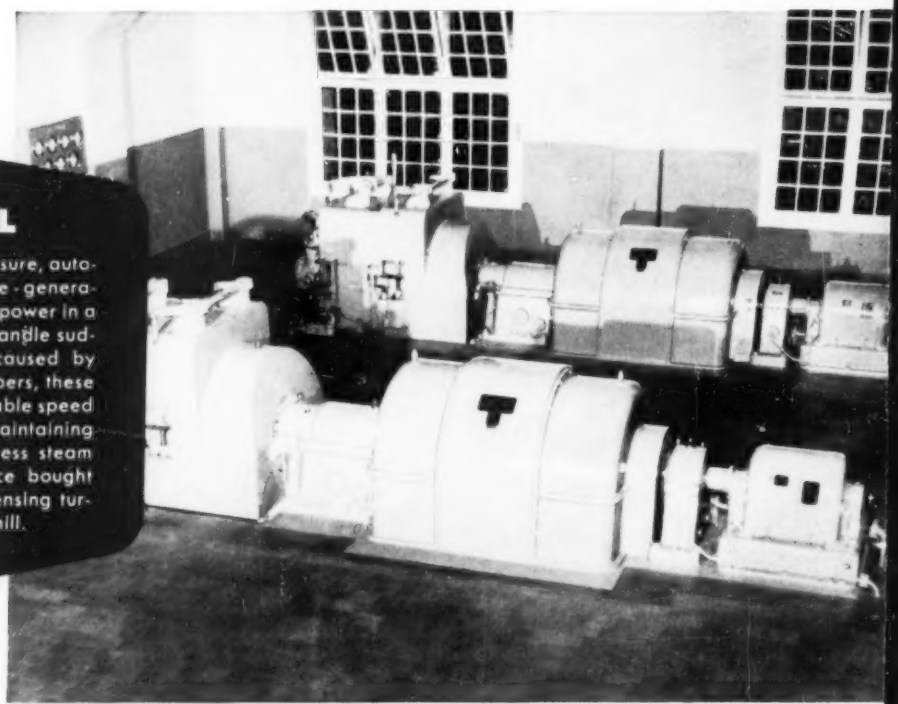

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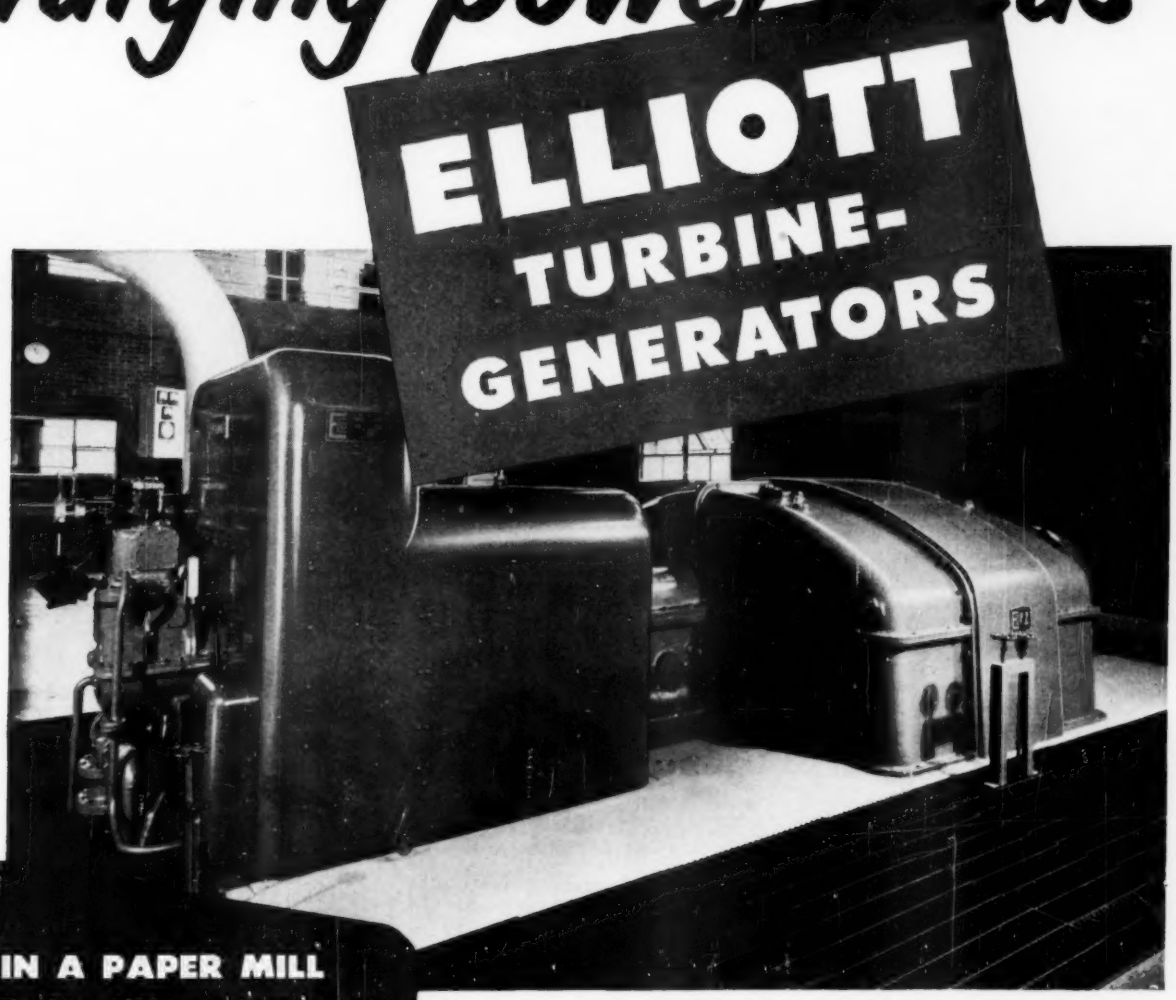

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User Explains How Armstrong Unit Trapping Boosted Output:

Need for Investment in New Steam Equipment Eliminated by Only $550.00 in Steam Traps

THIS is a story about greatly increased efficiency in a laundry, but the principles involved apply to any plant using steam heated equipment.

In speaking of the benefits derived from Armstrong Unit Trapping, Earl Fast of Soft Water Laundry and Cleaners, Long Beach, California, said, *"It's like a man with dirty eyeglasses—he thinks he's seeing perfectly until he cleans the glasses and finds out what he has missed."*

Mr. Fast's plant modernized its entire return system in 24 hours, installing 71 Armstrong traps costing about $550, with these results:

1. Capacity of machines costing as much as $15,000 per unit increased to the extent that new machines are not now required.
2. Higher quality of ironing and finishing, with touch-up on shirts eliminated.
3. Worthwhile fuel savings.

"Our boiler was turning out plenty of steam," continued Mr. Fast, "but we weren't getting the benefit of it. The best power plant in the world is of no value if you don't use its produced steam to maximum efficiency."

And there lies the case for Armstrong Unit Trapping, which discharges air and condensate as fast as it accumulates to keep steam heated equipment hot and producing at a peak rate. Your local Armstrong Representative will be glad to survey your condensate drainage system without obligation. Call him or write:

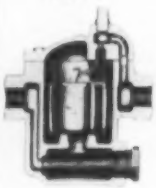
ARMSTRONG MACHINE WORKS

810 Maple Street • Three Rivers, Michigan

Traps with Built-in Strainers Cut Costs

Because the piping at Soft Water Laundry was old, the smallest-sized traps needed protection against dirt and scale. Armstrong No. 880 and 881 traps with built-in strainers were the logical answer because:

1. They cost less than a separate trap plus a strainer.
2. They eliminate external fittings and considerable installation labor.



Left—Cut-away view showing strainer screen at trap inlet. Strainer can be cleaned without removing or shutting off steam.

You always get more out of equipment when you use Armstrong "Unit Trapping"

FREE
44-PAGE
STEAM TRAP BOOK
Gives Complete Information
MAIL TODAY!

FILL IN AND CLIP TO YOUR COMPANY LETTERHEAD

ARMSTRONG MACHINE WORKS
810 Maple Street, Three Rivers, Michigan

Please send me a Steam Trap Book.

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Title .....

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Subscription Information—Published Monthly. Price: United States and Possessions $10, Canada $11, one year. Other countries $12.....Single copies $1.00.

NBP *Indexed in the Industrial Arts Index and the Engineering Index on file in Public Libraries*

CCA *Acceptance under Section 34.64 P. L. & R., authorized. Publication office, Concord, N. H.*

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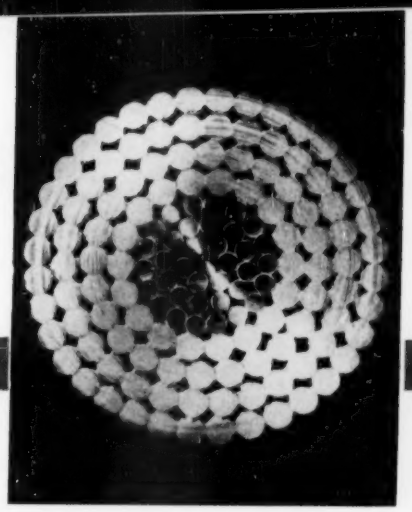
JANUARY 1953
VOL. 57 • NO. 1



Largest steel core, aluminum power cable in world will carry power to smelter at Kitimat, B. C. It is over 2½ in. in diameter

Power Engineering

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Population growth is a primary factor in the continual increase in the use of electrical energy in the U. S. Depressions, recessions, and war seem to be of secondary influence. By 1970, the electrical load is expected to reach a trillion kilowatt hours. Reserve generating capacity now 9.3 per cent, will rise to 17 per cent by end of 1955 when capacity will reach 118 million kw

Bigger and Better Power Plants to Meet Soaring Demand Economically..... 70
By Chester R. Earle

Power engineers are using many methods to build bigger and better power plants. They are designing, building and using: boilers up to 1,400,000 lb per hr each; turbines up to 200,000 kw capacity each, with talk of building 250,000 and even 300,000 kw units; great increase in use of reheat units; increase in steam pressures up to 2300 psi, steam temperatures to 1050 F and in at least one case 1100 F; outdoor and semi-outdoor plants; centralization of controls; improved maintenance programs; gas turbines for power generation; pumped storage hydroelectric projects; atomic power plants

New Principles, New Materials—Keys to Electrical Progress.. 76

Tremendous expansion of the electrical industry due in large measure to the continual discovery of new principles and new materials. It is the basic research in principles and materials which makes possible the construction of 250,000-kw generators and 330,000-v transmission systems. Recent development in field of semi-conductors to have profound influence on industry

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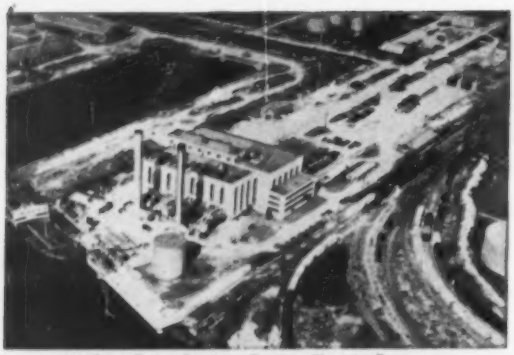
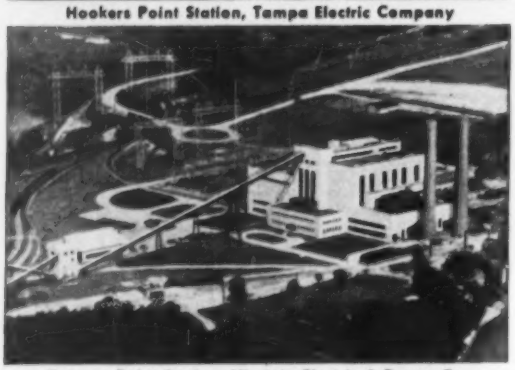
The only magazine devoted exclusively to the job interests of power engineers



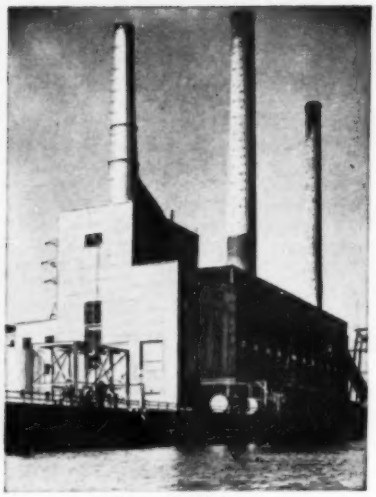
Hookers Point Station, Tampa Electric Company



Possum Point Station, Virginia Electric & Power Co.

Louisiana Station, Gulf States Utilities Company

Venice No. 2 Plant, Union Electric Power Company



Riverside Station,
Savannah Electric & Power Company

Designed & Constructed
by
Stone & Webster
Engineering Corporation
and using

OIC Valves are *precision engineered* and *precision built*. OIC engineers offer you *precision application* help.

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ENGINEERS' PREVIEW

RESEARCH HAS TURNED UP another useful and unusual property of glycerine. The phenomenon, termed photoviscosity by its discoverers, W. W. Hagerty and R. A. Yagle, can be observed when glycerine is made to flow through a transparent pipe containing baffles or other obstructions which interrupt the smooth flow of the liquid. Without the aid of any special lighting arrangements, the streamlines of the pattern of flow are clearly visible in the glycerine.

More remarkable is the fact that the lines persist in the stationary liquid for 30 to 45 min. after the flow has been stopped suddenly, so that the flow pattern can be analyzed and photographed in a fairly leisurely manner. To date, this property has not been observed in any other liquid. Ordinarily, such tests require special arrangements of lights and polarizing screens or the suspension of foreign materials in the liquid to make the streamlines visible. The nature or cause of this unusual property of glycerine is as yet unexplained, but it has nevertheless proved to be a useful tool in the engineering laboratory.

★ ★ ★

TO DEVELOP better smoke filters, the scientists at the Naval Research Laboratory have developed an optical device to accurately measure the size of aerosol particles (minute particles suspended in the air). They use the principle that aerosol particles change the angle of polarization of a beam of light going through the air.

A research report PB 104 372, entitled — Development of NRL Photo-electric Particle-size Meters — describes this device and an electronic arrangement which increases its sensitivity so that changes of 0.0002 microns in aerosol particles radius can be detected.

This report of 72 pages, including photos, drawings, graphs and tables sells for $10.00 in photostat and $3.50 in microfilm form. Orders should be addressed to the Library of Congress, Photoduplication Service, Publication Board Project, Washington 25, D. C., accompanied by check or money order payable to the Librarian of Congress.

★ ★ ★

WHAT APPRENTICESHIP IS, the occupations in which apprentice training is given, how apprenticeship programs are established, the functions of the Bureau of Apprenticeship, U. S. Department of Labor, State apprenticeship agencies and joint management-labor apprenticeship committees are explained in this 1952 edition of a 32-page booklet called The National Apprenticeship Program.

Copies of this new and enlarged edition can be obtained free of charge by communicating with the Publications Branch, Bureau of Apprenticeship, U. S. Department of Labor, Washington 25, D. C. When requesting copies, please mention POWER ENGINEERING and the issue.

★ ★ ★

LEAD ASSUMES THE PROPERTIES of spring steel and rings like a bell when struck, a miniature steam engine runs with ice as the only fuel, and an atomic power plant is shown in mock-up in the latest Westinghouse science show — Energy in Action.

Designed to show the progression of science towards the atomic age and the ever increasing utilization of energy by the world today, the 8-act, 90 min production is given predominantly to demonstrations by two Westinghouse science reporters. A two-hour version of the show includes a color movie, Energy is Our Business.

In a demonstration of the effect of ultra-coldness on lead, liquid nitrogen at a temperature of minus 321 F is employed. When the normally soft lead is immersed in the liquid nitrogen, it assumes the properties of a steel spring and resounds with a bell-like tone when struck.

Micarta, the laminated plastic, is actually made on the stage during the show, and its insulation properties are demonstrated by comparing the effect of an electric arc on the Micarta to the effect of the same arc on a block of wood of greater thickness. The wood is burned through in a very few seconds while the arc is forced to detour around the Micarta.

The atomic power plant of the future as envisioned by Westinghouse engineers, the designers of the first atomic powered submarine, is shown in colorful mock up and is described by one of the science reporters. The show was produced by R. A. Roxas, manager of the Westinghouse Motion Picture Department.

★ ★ ★

SOLID GLASS, which becomes liquid and acts as a lubricant at high temperatures, will be the key factor in the Ugine-Sejournet process of hot extruding steel now being used by some steelmakers and fabricators in the United States. This process may have great influence on the manufacture of turbines and other power plant equipment.

In the hot extrusion process, very hot steel is forced through a die to make bars, shapes and tubes. Items such as tubing for hollow turbine blades, which would be difficult or impossible to roll economically can be readily hot extruded. Some kinds of steels and superalloys which can be rolled only with great difficulty, can be formed by hot extrusion without trouble. Small orders of special steel shapes may be economically hot extruded through a die, where the manufacture of rolls and the necessary adjustments to a rolling mill would be disproportionately expensive.

Glass or glass-like material was discovered to be the only product that acted as a good lubricant for hot steel being thrust through a die, while simultaneously protecting tools from contact with the steel and insulating them from excessive heat. Originally, plate glass was used, but recent experiments have proved that woven or fibrous glass is just as effective and easier to handle.

★ ★ ★

HOW AMATEURS can now produce stereo movies as easily as they produce flat 8 or 16 millimeter pictures has been demonstrated during the convention of the Photographic Society of America at the New Yorker Hotel in New York City, August 12–16. Details of the process are not given but we understand that it can be done with present 16 mm equipment. This seems an interesting development for power engineers to watch, because there are several places in the power plant in which motion picture photography has already yielded some information that could not be obtained in any other way, and in which the extension of this technique by stereo movies would increase them a great deal. For example, many power engineers will remember seeing the splendid motion picture films taken in various types of furnaces, fired with both pulverized coal and stokers, by the engineers of both Combustion Engineering-Superheater, Inc., and the Babcock & Wilcox Co. These were shown first at ASME meetings in New York and have since been shown at other engineering meetings throughout the country. So far as we know they are still available to those interested in studying them under the supervision of the makers. Power plant men who have seen these pictures can readily understand how much more they would show if made as stereo films.

★ ★ ★

SOME DAY SOON you may see electric power developed from a swimming pool. For that is the name given to a new type of relatively inexpensive, low-power nuclear reactor, unique in that it is submerged in water to protect operators from radiation. It was pioneered and developed by scientists at Oak Ridge National Laboratory which is operated for the Commission by the Carbide and Carbon Chemicals Co., a division of Union Carbide and Carbon Corp.

The reactor is the central feature of a

bulk shield testing facility used for experiments to aid development of improved reactor shields. The facility is popularly known as the "swimming pool," since the reactor is submerged in a pool of water 20 ft deep, 20 ft wide and 40 ft long, in which it can be moved about. The entire equipment was constructed for less than $250,000, exclusive of fuel, and that is an extremely low price for any sort of nuclear reactor. The swimming pool reactor has a continuous, full load power rating of 10 kilowatts, and because of its low cost, simplicity and performance, is one of several types that may be suitable for use at schools and other research and training institutions.

★ ★ ★

WILL GAS RECIRCULATION give you the steam temperature control you need? Well, it is a feature of more than a hundred boilers in service or on order, according to P. R. Loughin of B & W at a meeting of the PEA Prime Movers Committee. Gas recirculation as a supplementary or alternative means of controlling superheat and more recently reheat temperature was first used at the Vienna Plant of the Eastern Shore Public Service Co. R. M. Mullen showed the meeting how it produced fine control on the Vienna units and reported that it was considered a wholly successful innovation.

Combination of gas recirculation with high temperature and reheat operation complicates the problem of automatic control of total steam temperature. More than half the heat put into the steam is now used in superheating at 1050 and 1100 F. Accordingly, said P. S. Dickey of Bailey Meter Co., this, with the correspondingly increased mass of metal in the superheaters, introduces time lags up to six minutes in response. To overcome this delay in the controls, they have been shifted to gas flow and steam flow with a temperature differential device added in the case of gas recirculation.

E. D. Scutt of Leeds & Northrup Co. described new methods of temperature control in high temperature steam generating units, saying that this control has become at least as complex as the combustion control.

★ ★ ★

IMPORTANCE to power engineers of the power loads and power uses of modern office buildings and of new ones to be constructed in the near future was forcibly brought home to them by C. C. Saunders of du Pont in describing the new du Pont suburban office building now under construction two miles from Newark, Del. This will house the company's central engineering department in 200,000 sq ft of space.

All power for the new building will be supplied from the Delaware Power & Light Company's new substation three miles away. An interesting feature will be the comparatively novel 480/277 volt system for operation of the fluorescent lights that constitute the major portion of the electrical load. This system saves materials and cost. Escalators, motors, X-ray machines, roadway and parking lighting, snow melting facilities and many other electrically operated devices are supplied from transformers in the building. The snow melting equipment includes soil heating cables buried in concrete at the front entrance, controlled by an outdoor thermostat and a master switch. Roadway lights are controlled by a time clock and a photoelectric set. Mr. Saunders claims the building's electrical design has such features as reliable distribution, good voltage regulation, provision for voltages needed now and also in the future, good lighting conditions for future expansion.

★ ★ ★

POLYTRIFLUOROMONOCHLOROETHYLENE, less technically known today as Kel-F, is a plastic that power engineers may hear more about in the future. It had its origin in connection with the development of special materials for the Oak Ridge Atomic Energy Plant, and has been produced on a commercial basis by M. W. Kellogg Co. since 1947. It was originally developed as a corrosion resisting material but now Kellogg is building a new million dollar plant at Jersey City for increasing the commercial production of Kel-F for military and industrial purposes.

The material is designed to withstand high and low temperature, has high dielectric strength and a low rate of moisture absorption. It is extremely moldable and a hermetical seal can be obtained between Kel-F insulation and metal inserts.

Power engineers may find it applied in construction of valve diaphragms, valve seats and gaskets, "O" rings, glass-filled valve seats, drum and tank liners, packing, washers, coated wire, coil forms, rotary electric switches, transformer terminals and many machined electrical and chemical fittings.

★ ★ ★

PRESIDENT TRUMAN'S special commission reporting on status of U. S. fuels, foresees sharp rise in demand for coal. Strong support for the long-term view that coal consumption in the United States will be greater than ever in the years ahead is contained in the recent report of the President's Materials Policy Commission. An analysis of this report by the Bituminous Coal Institute points out that the commission, in its study of the country's raw materials and our production requirements in the year ahead, comes to the conclusion that coal consumption in the U. S. in the course of the next 25 years will reach a level of more than 800 million tons annually, as contrasted with the present 500 million-ton-level. The commission projects an even higher figure than the 800 million tons annually if coal is required to take over more of the energy load now being carried by petroleum and natural gas.

The Bituminous Coal Institute calls attention to that portion of the report which emphasized that coal is not only a major source of fuel but, as carbon, is a raw material for a wide variety of industries, and that "sooner or later several major industries will have to sink their tap roots deeply into our coal reserves, as did the railroads earlier."

★ ★ ★

AS A FURTHER STEP in the great industrial expansion of Canada, the production of an important variety of chemical and process industries equipment will soon begin there as a result of negotiations now being carried on by some of Canada's largest mining and manufacturing companies with Knapp Mills, Inc., of New York City.

The American company produces Ferrolum lead-clad steel and Cupralum lead-clad copper, both of which are rapidly becoming standard throughout the United States for use in the production of acids and chemicals, electro-metallurgical processes, petro-chemical products, the nuclear industries and in Government Ordnance.

★ ★ ★

A "MORE POWER TO AMERICA AWARD", for the electric utility companies that do the most to foster industrial electrification during 1952 and in each succeeding year, has been announced by the Committee on Prize Awards of the Edison Electric Institute.

Sponsored by the General Electric Company, the new award is designed to "increase the productivity of American industry by encouraging creative, broad-scale industrial electrification activity among America's electric utility operating companies, and to bring recognition to the companies and individuals making the greatest advancement in this field each year."

The first award will be made by EEI at its 19th Annual Sales Conference in Chicago, April 1, 1953. All electric utility operating companies are eligible.

★ ★ ★

A MULTIMILLION-DOLLAR transformer manufacturing plant, providing employment for about 1700 persons, will be built at Rome, Ga., by the General Electric Company.

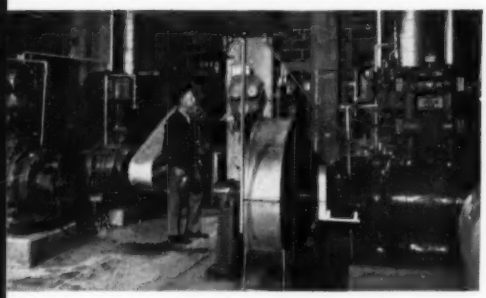
Its construction will be begun at once and will be completed by mid 1953. The plant will consist of two large manufacturing buildings, an office building, and a number of outlying service buildings.

★ ★ ★

ELLISON DRAFT GAGE CO., INC., founded in 1896, has moved to modern, larger quarters at 548 W. Monroe St., Chicago, Ill. The firm was formerly located at 214 W. Kinzie St., for nearly 50 years.

450 TONS OF ICE can be safely stored in this room. All of it is needed for concessions at Hershey Park and for domestic consumption. The supply is always dependable, thanks to Suniso.

THE HERSHEY BEARS AVERT A SCORE. The ice for this sports arena has been supplied with the help of a Suniso Refrigeration Oil for about six years. With a previous oil, compressor breakdowns were a constant threat to the sports program.



TEMPERATURES FROM −50F to +50F are supplied by these Frick ammonia compressors. They circulate brine through coils in the ice plant and under the arena floor, and ammonia through coils in the cooling and quick-freezing rooms. One grade of Suniso lubricates all of these compressors. Overall efficiency has been 15 percent better ever since its adoption.

75 TONS OF PEACHES AND APPLES are stored at 31F to 35F. Nearby are cold rooms protecting potatoes, cheese and raisins at 38F to 40F, powdered milk for chocolate at 40F; a quick-freeze held at −40F to −50F; frozen food storage at −6F to −8F. These rooms are all serviced by the same central system which handles the arena and ice plant.

COMPRESSOR EFFICIENCY BOOSTED 15% BY SUNISO

The refrigeration compressors which service the Hershey Sports Arena, home of the Hershey Bears, are part of a central system which also takes care of an ice plant, frozen food lockers and cold storage rooms. About six years ago, the compressors were losing efficiency because of an inadequate refrigeration oil. It formed excessive lacquer and carbon deposits, which clogged the lines and made frequent overhauls necessary.

To solve the problem, management called in a Sun representative, and on his advice switched to a Suniso Refrigeration Oil. Suniso's natural detergency immediately began attacking the deposits throughout the system, carrying the sludge to traps and filters. Soon the system was entirely clean. Since then—over six years ago—the compressors have run at an overall added efficiency of 15 percent, and have always been equal to the heavy requirements made of them.

SUN OIL COMPANY, Dept.PO-1, Philadelphia 3, Pa.

If faulty lubrication is possibly costing you compressor efficiency, use this coupon to get: ☐ the services of a Sun representative, ☐ a free copy of the technical bulletin "Lubrication of Refrigeration and Air Conditioning Equipment."

Name_____

Title_____

Company_____

Street_____

City_____ Zone_____ State_____

SUNISO REFRIGERATION OILS

SUN OIL COMPANY, PHILADELPHIA 3, PA. • SUN OIL COMPANY, LTD., TORONTO & MONTREAL

SUNOCO®

What's New IN BOILER

Yarway Remote Liquid Level Indicator, manometric type, with automatic temperature compensation.

IMPROVED *WIDE VISION* REMOTE LIQUID LEVEL INDICATOR

A new-type face on the Yarway Remote Liquid Level Indicator now permits side as well as head-on dial readings. This vastly improved visibility makes it possible to check boiler water levels from most any position in the control room, or wherever the Yarway Remote Indicator may be installed.

MANOMETRIC TYPE

The Yarway Indicator is a manometric type with automatic temperature compensation. Level readings are instant and accurate because the indicator is operated by the boiler water itself. The indicating mechanism is never under pressure. There are no stuffing boxes.

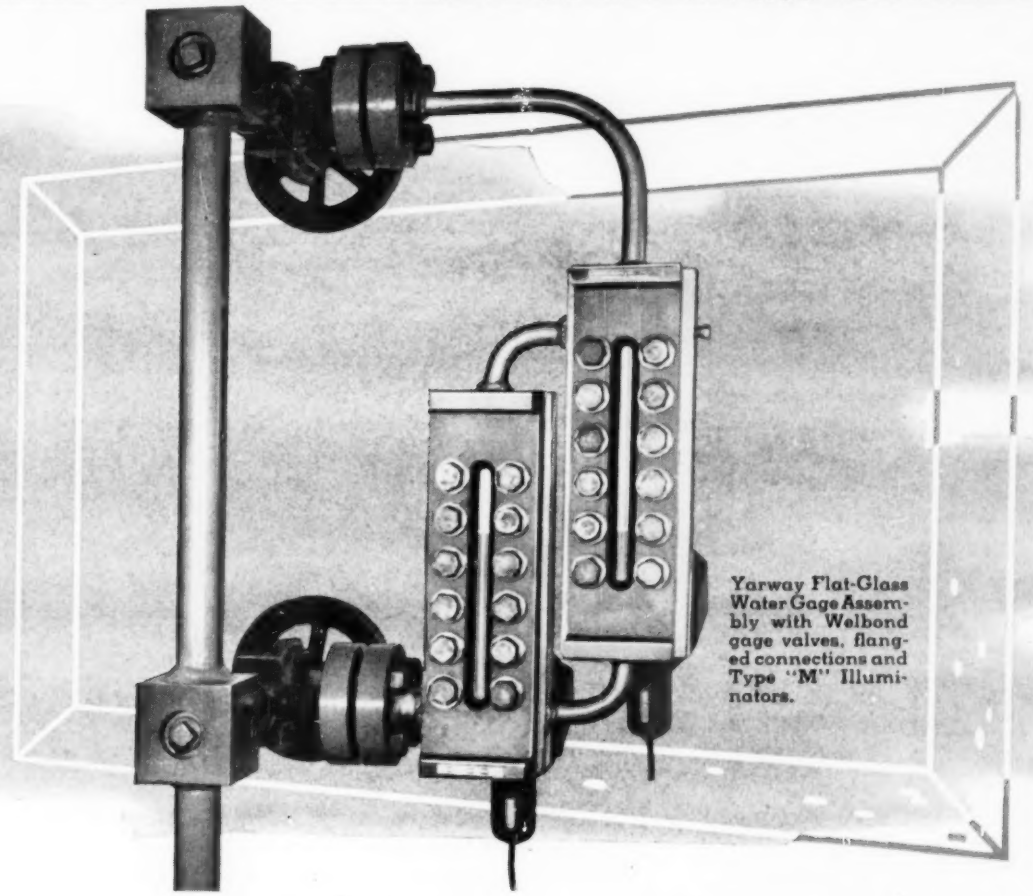
Over 8,000 Yarway Remote Liquid Level Indicators are successfully operating throughout industry — primarily for indicating boiler water levels, but also for many other liquid level applications, and for superheater pressure differential indication aboard ship.

For full information on Yarway Indicators, write for Yarway Bulletin WG-1823.

YARNALL-WARING COMPANY • 114 Mermaid Avenue, Philadelphia 18, Penna.

YARWAY®

WATER LEVEL INDICATION?



Yarway Flat-Glass Water Gage Assembly with Welbond gage valves, flanged connections and Type "M" Illuminators.

NEW *SEPARATED-DESIGN* WATER GAGES

This new Yarway water gage assembly has been developed to meet the demands for greater dependability, longer life, and more accurate readings in high pressure service.

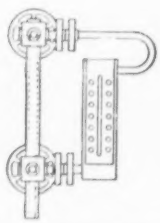
The gage glass inserts are of the Yarway pressure-sealed "floating assembly type". Yarway Welbond gage valves are used. Greater flexibility is gained by using two independent inserts, and by interconnecting expansion loops (see above).

The short connection to the drum assures greater accuracy of the gage reading, and the lower flanged connection eliminates a stuffing box. The upper flanged loop connection between the insert and gage valve allows expansion and contraction of the various components.

The tie bar-type water column linking the gage valves provides circulation to keep gage nearer drum temperature.

Yarway Type "M" Illuminators on the gage inserts cause the meniscus at water level to "shine like a star". This illuminator is especially effective in penetrating deposits on gage glass, dust particles in air and extraneous light.

For full information, write for Yarway Bulletin WG-1811.



Yarway Single Insert type gage for medium range of visibilities.

STEAM PLANT EQUIPMENT

For more data circle 505 on Post Card

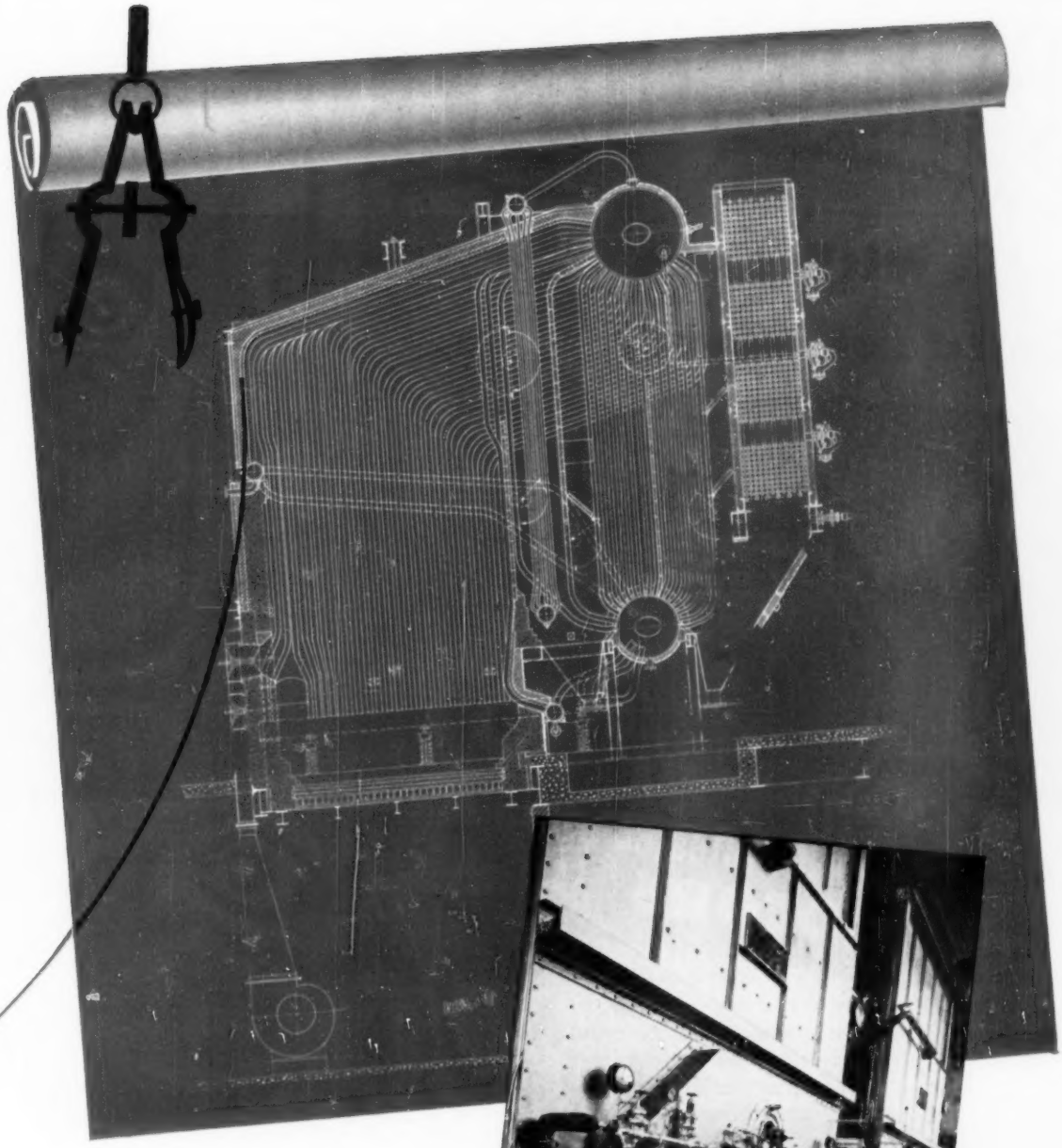
M.I.T., famous engineering school, uses WICKES boilers for steam production

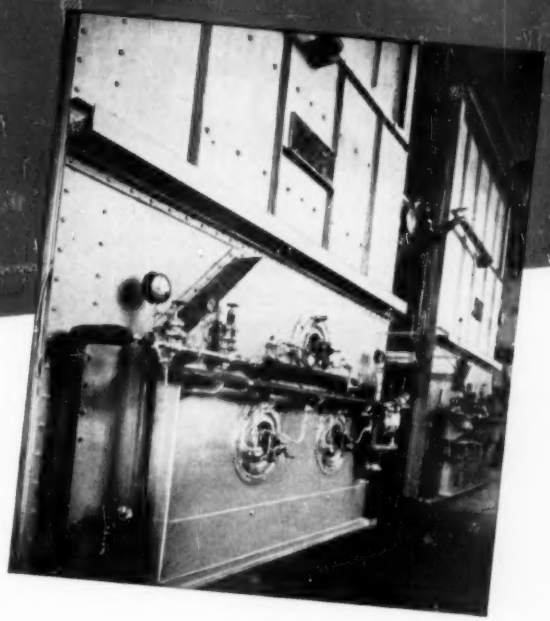
Consultants — JACKSON & MORELAND, ENGINEERS of Boston, Mass.

AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY, where sound engineering principles are taught, two Wickes Steam Generators were selected to supply heat for several new buildings inciuding the Hayden Library and Sloan Metals Research Laboratory. The Wickes Boilers, which were custom-engineered for M.I.T., produce 160,000 lbs., of steam per hour. They occupy the same space formerly occupied by the two old boilers that produced only 40,000 lbs. per hour. They are equipped with superheaters and economizers. The new boilers are oil-fired at present but are engineered for ready conversion to spreader stoker if desired. They are designed for quick steaming to meet emergency power requirements and are fitted with thermowells and openings for taking flue gas samples so the students at M.I.T. can run boiler tests as part of their instruction. The installation of these boilers, an extremely difficult job because of the close erection tolerances, was handled by Flagg, Brackett & Durgin, Inc., Wickes' agents in Boston. ' ' '

Wickes can fill your requirements for steam generators up to 250,000 lbs. per hour and 1000 psi.—all types of multiple drum boilers adaptable to any standard method of firing; oil, gas, underfeed or spreader stoker. Write today for descriptive literature or consult your nearest Wickes representative.

RECOGNIZED QUALITY SINCE 1854





ABOVE: Blueprint diagram of one of the Wickes Steam Generators at M.I.T.

RIGHT: View showing the two Wickes Boilers installed in the power plant at M.I.T.

WICKES

THE WICKES BOILER CO.

142

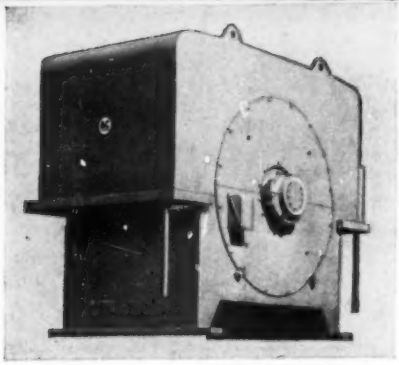
DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

SALES OFFICES: Atlanta • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver • Detroit • Greensboro, N.C. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Pittsburgh • Portland, Ore. • Saginaw • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D.C.

For more data circle 506 on Post Card

NO HOUSING PROBLEM

. . . with this Outdoor Motor



BEST WAY to solve a housing problem is to eliminate the need for housing! That's exactly what the Allis-Chalmers weather-protected motor does. It eliminates the need for a costly building . . . costly in added capital investment, costly in upkeep, and costly in extended construction time.

Proved by Special Tests

We know this weather-protected design can give you these savings . . . plus dependable performance . . . because we've tested it under extreme conditions.

Take the 900-hp, 435-rpm, 4160-volt motor shown above. While running at normal speed and voltage, it was deluged with water at rates up to 40 inches per hour — driven by winds up to 75 miles per hour. This was done repeatedly from all angles. But on inspection, no moisture was detected on the windings of this weather-protected motor.

And other tests checked its effectiveness in keeping out wind-driven fine sand.

Bulletin Describes Features

The construction features that provide this economical, super-splashproof performance are available in ratings for all major auxiliary drives. For more information, ask your nearby A-C representative for Bulletin 05R7874, or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-3907

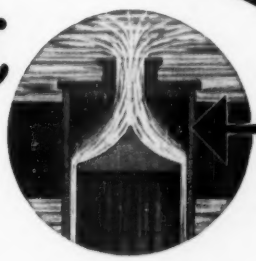
ALLIS-CHALMERS

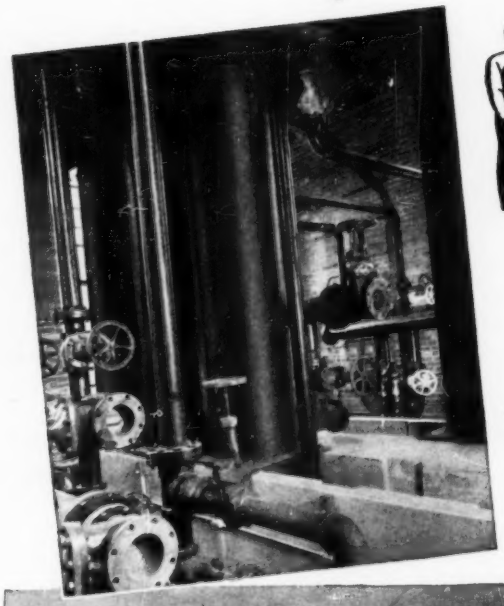
A-C ALLIS-CHALMERS

For more data circle 507 on Post Card

Dirty Water can't "Shut-down"...

Vogt

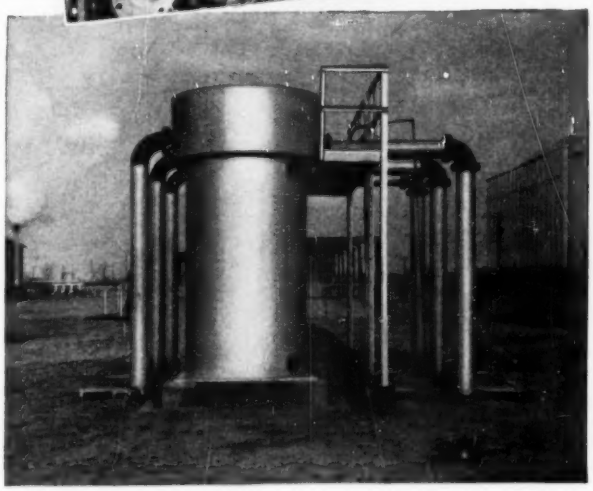




film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

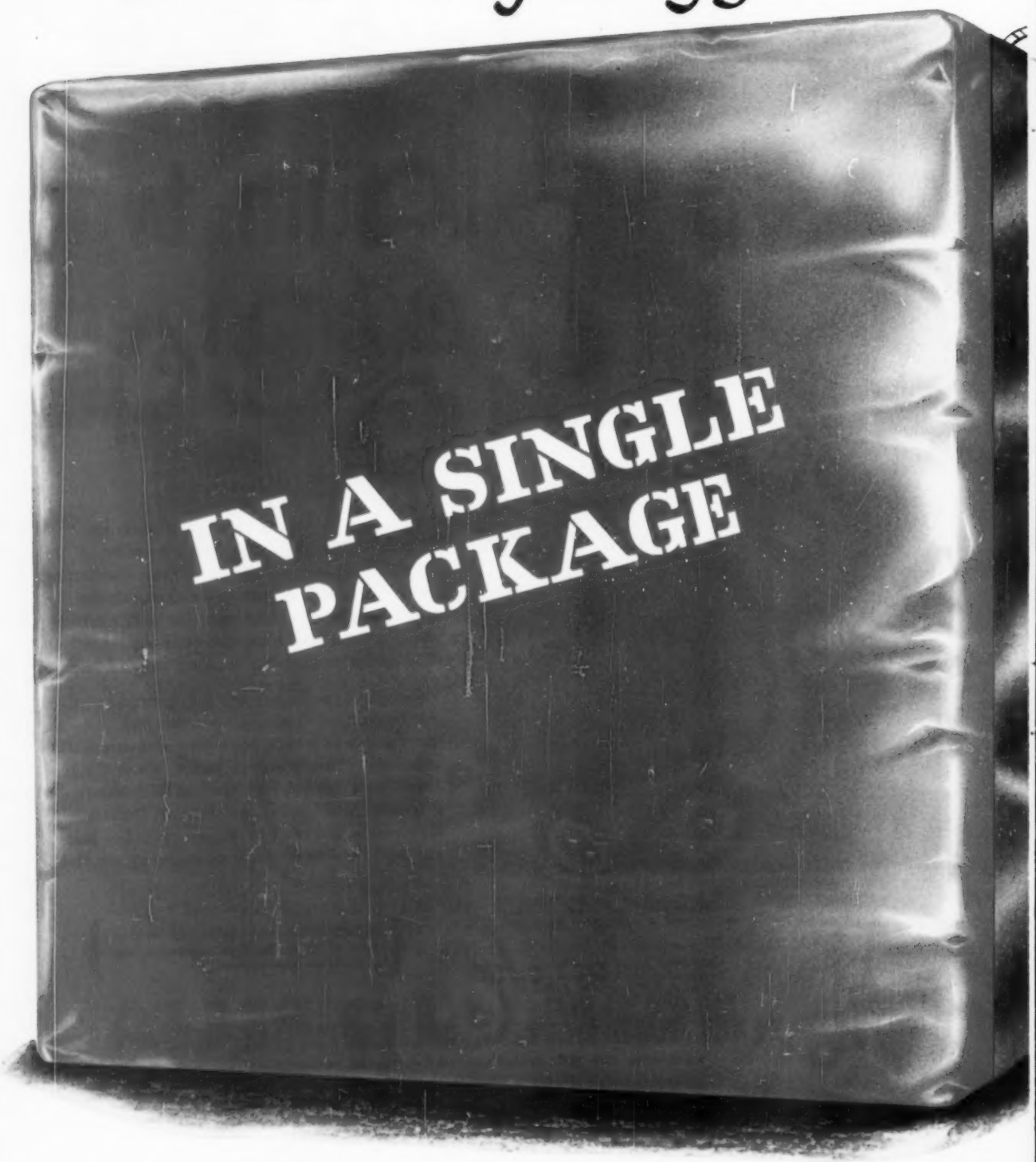
[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

For more data circle 508 on Post Card

Something New...
Something Bigger!



COMBUSTION CONTROL

From steam flow—air flow, or by the fuel air ratio method. Designed especially for the most modern central station boilers, but well suited for smaller units.

FEED WATER CONTROL

From three, two or one influences. Instrument or mechanical types to meet all operating conditions or preferences. Adaptable to all piping layouts.

STEAM TEMPERATURE CONTROL

Multi-element type. Through burner or damper positioning, gas recirculating, direct cooling-water spray or heat exchanger.

SOOT BLOWER CONTROL

May be full automatic-sequential control or individual push buttons. Each step in the blowing cycle can be reported back to the panel by signal or program lights.

MINIATURE or STANDARD INSTRUMENTS by *Taylor*

Miniature instruments, especially with auto-manual selector valves, are ideal for modern space-saving and graphic panels. Standard size instruments also available.

COPES-VULCAN DIVISION, CONTINENTAL FOUNDRY & MACHINE COMPANY, ERIE, PA.

ASK FOR BULLETIN 1007

COPES VULCAN

BOILER CONTROLS

ENGINEERING News

HERE'S THE INSIDE STORY ON SK EVAPORATORS

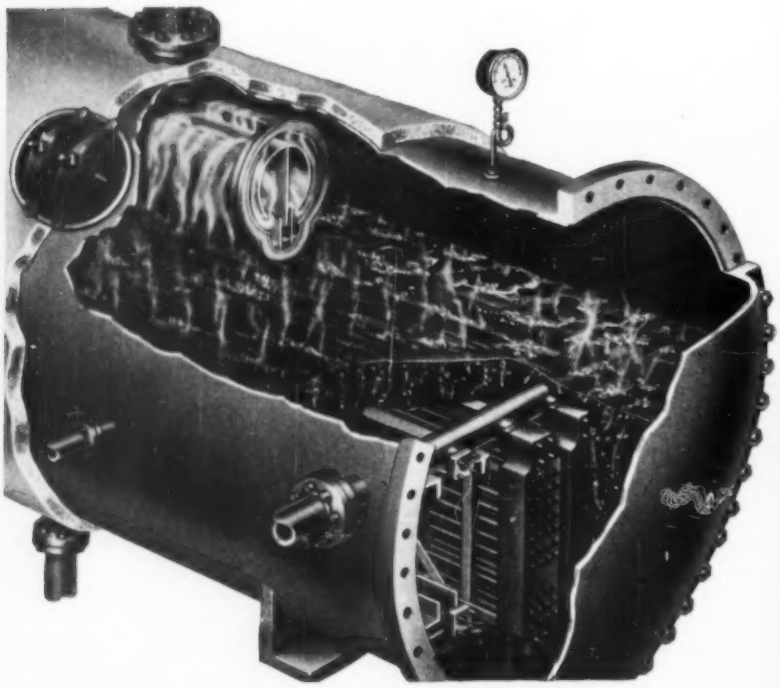
SK Evaporators of the type illustrated help reduce deterioration by providing distilled make-up water for modern boilers.

Designed and built, not to meet a price, but to provide sound engineering advantages, careful workmanship and A-1 materials with resultant *long range economy*, SK Evaporators offer real cost saving in operation and upkeep.

A look inside of this evaporator shows large liberating and tube surface areas which assure maximum heat transfer and high efficiency. The straight, special design, self-scaling tubes are mounted in easily removed bundles to facilitate maintenance and cleaning. A centrifugal separator, located inside the shell, prevents carry-over of moisture.

SK Evaporators are manufactured in various designs for stationary steam plants, for marine and other installations where the use of distilled water is desirable.

For engineering information on SK Evaporators, please write this company explaining your requirements.



The valve, illustrated, is one of four SK 12″ Fig. 816XX high-pressure boiler Non-Return Valves recently installed in the power plant of a large utility in the St. Louis area. These valves are installed on boilers generating steam at 980 psi gauge and 915° F. and are used as stop valves to shut off flow from the boilers and as check valves to prevent backflow. They are constructed of Chrome Molybdenum Alloy Steel. All pressure castings were radiographed and magnetic particle inspected to assure best possible quality and freedom from defects.

Design features include: (1) Compact design requiring minimum headroom; (2) Pressure seal bonnet construction; (3) Free area, streamlined construction resulting in low pressure loss; and (4) Readily accessible parts for easy maintenance. These valves can be built for manual or motor operation.

SCHUTTE and KOERTING Company
Manufacturing Engineers
54 CORNWELLS HEIGHTS
BUCKS COUNTY, PA.

For more data circle 510 on Post Card

Power Engineering

WEEK IN NEW YORK

ON THE pages that follow, you will find a pictorial record of the activities of the POWER ENGINEERING staff in New York City during the week from November 30 to December 6, 1952.

During that week, New York City's hotels, auditoriums and meeting rooms bulged with a tremendous assemblage of the country's leading industrialists and engineers. They were attending the 20th National Power Show, annual meetings of the American Society of Mechanical Engineers, the National Association of Manufacturers, the American Society of Refrigerating Engineers and others.

Into this maelstrom of technical erudition, POWER ENGINEERING'S staff of editors and district managers plunged with camera and notebook. Pictured here are a few examples of what they saw and heard.

Otto Manz (left center), A. R. Collard (far right) of Consolidated Edison watch Emil Skubik (left) and C. R. Earle, POWER ENGINEERING, show St. Clair model, booth 12

Scores of exhibitors, hundreds of new ideas, equipments and materials—brilliant with color—this view was taken just before the 20th National Power Show opened its gates at Grand Central Palace, New York, to thousands of engineers

20th NATIONAL POWER SHOW

Wintry weather and Lexington Avenue's traffic failed to prevent hundreds of engineers from lining up at Grand Central Palace's entrance to wait for the opening of the Power Show

BETTER THAN EVER — more color — more "live" equipment — better demonstrations — bigger crowds of visiting engineers — those were the chief impressions of both exhibitors and visitors at the 20th National Power Show, Grand Central Palace, New York City, December 1 to 6, 1952. (The show is officially the National Exposition of Power and Mechanical Engineering.) This Power Show, like that of 1950, was held under the auspices of the American Society of Mechanical Engineers, which was holding its 1952 annual meeting from November 30 to December 5 at the Hotel Statler, New York.

Approximately 40,000 registrations of visitors were recorded at the show. Exhibitors numbering 350 occupied 3 floors of the Palace to the last available space.

These exhibitors showed much of the equipment involved in the present and forthcoming developments in large high-pressure and high-temperature units. New combustion controls, feedwater controls, new and smaller types of instruments and benchboards and other features of centralized power plant controls were featured. At one booth, total system load of Consolidated Edison was being recorded. Several complete package boilers were displayed.

Television for remote observation of water level, furnace interiors, stack emissions and many other industrial uses, as an aid in centralizing automatic controls, was also featured.

Power plant auxiliaries of all types — pumps, blowers, compressors — were shown in profusion. There were displays of motors and controls; coal and ash handling and coal storage equipment; water columns, blowoff valves, steam traps of all types; refractories and furnace materials.

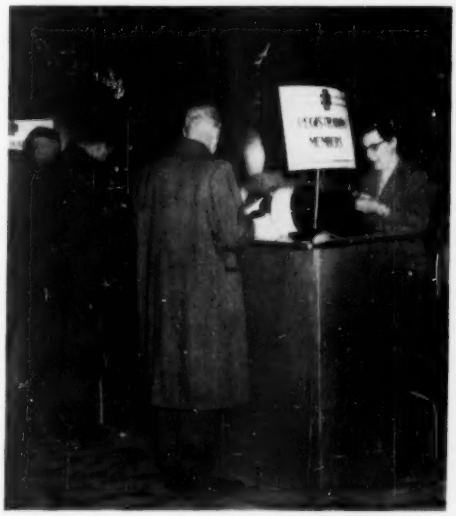
ANNUAL ASME MEETING—1952

PROBLEMS in the operation of large high-pressure, high-temperature boilers and turbines, as well as of smaller boilers and stokers — gas turbine design and application — boiler feedwater — high-temperature metals and alloys — management — engineering education — aviation — wood industries — textile problems — to say nothing of interstellar space rockets — were all covered at the 1952 annual meeting of the American Society of Mechanical Engineers (ASME). That meeting was held November 30 to December 5 in New York City. Main headquarters were in the Hotel Statler, but the meeting was so big it spilled over and some sessions were held in the nearby Hotel McAlpin. About 7000 ASME members registered for the meeting. The society has now grown to more than 38,000 members.

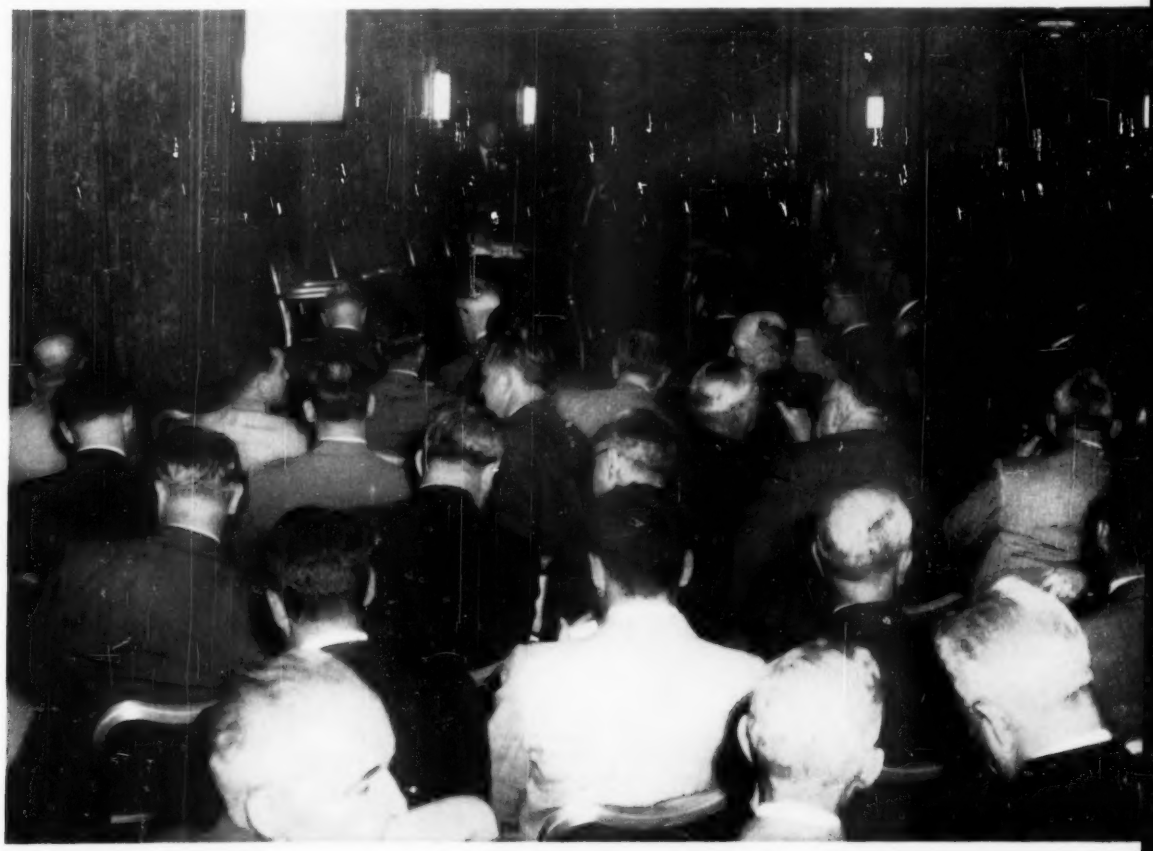
At the annual business meeting of the society, Frederick S. Blackall, Jr., was elected president for 1953, succeeding Reginald J. S. Pigott, the 1952 president. New regional vice presidents elected were: Henry R. Kessler, Paul R. Yopp, Ben G. Elliott, Harry R. Pearson. Many honors, medals and awards were conferred on members, at the annual banquet, for their achievements in various branches of mechanical engineering, as shown elsewhere in this section.

For power engineers, especially well-attended and noteworthy were technical sessions on: quick starting of boilers and turbines; gas turbine power; liquid metal heat exchangers; boiler feedwater and industrial water treatment; hydraulic turbines and large pumps; burning of wood waste in suspension and on stokers; air preheater design; heat exchangers; air pollution control. A number of these included panel discussions.

At the 1952 Annual ASME Meeting, held concurrently with the 20th National Power Show, this ASME registration desk in Hotel Statler, New York City, handled more than 7000 members



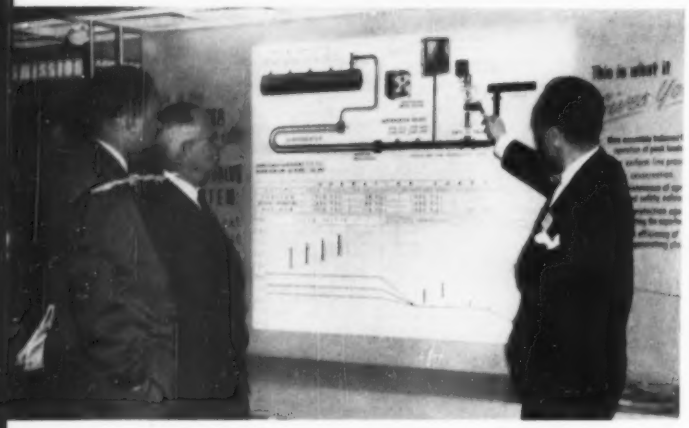
Practically every power plant engineer attending the 1952 Annual ASME Meeting jammed into the Georgian Room to hear J. C. Falkner of Consolidated Edison and R. L. Reynolds of Westinghouse explain quick starting of large boilers and controlled starting of large turbines and discussion from the floor



MONDAY...

A. B. Sanger, Sanger-Furnell, Inc., (left) and B. de Turenne, sales manager of Green Fuel Economizer Co., at Green's Power Show booth

(Below, left) R. F. Attner, production manager, Hancock Div., and A. W. Coleman, general sales manager, watch J. F. Higgins, advertising manager, show diagram at Manning, Maxwell & Moore, Inc.



(L to r) J. E. Stevens and J. E. Foley, Jr. of the Edward Valves, Inc. chat about valves with S. A. Tucker, publications manager, ASME

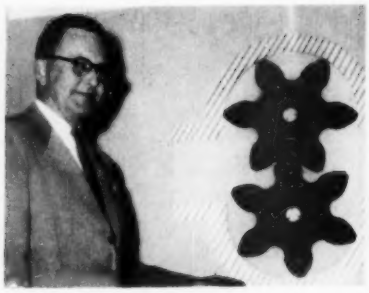
H. Meers of the Philip Carey Manufacturing Co. examines the official program for the Power Show

(L to r) H. A. Brangs, L. J. Wing Manufacturing Co., Frank Story, DeLaval Steam Turbine Co., and H. S. Wheller, president L. J. Wing

(Right) Mrs. Frank W. Miller, president, Woman's Auxiliary, ASME, and R. J. S. Pigott, 1952 ASME president, at President's Luncheon

(Left) C. W. Bell, Sr., consulting engineer and frequent POWER ENGINEERING contributor, attends the Annual ASME meetings at the Statler

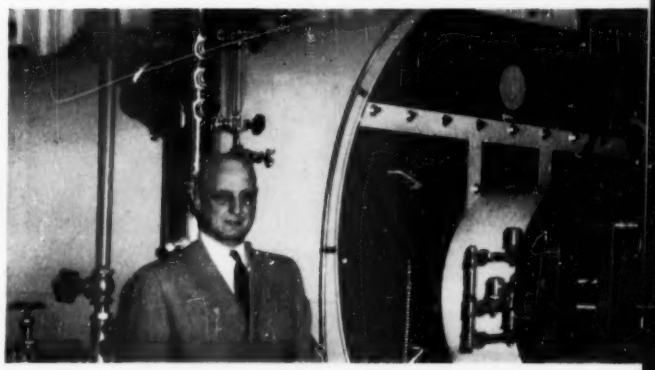
V. S. Krale, advertising manager of the Mercoid Company, stands in front of his company's attractive display of control equipment at the Power Show

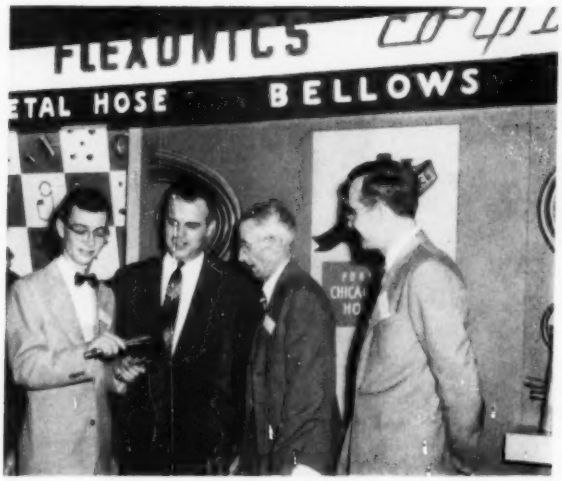


R. F. Corrigan, assistant advertising manager of the George D. Roper Corp., pointing to large, colorful gears demonstrating principle of equipment

J. C. Hobbs, consulting engineer, Coral Gables, Fla., and D. J. Mackenzie, H. G. Acres & Co., consulting engineers, examining preprints at ASME

(Right) G. E. DeSiena, vice president and sales manager of the Superior Combustion Industries, Inc., stands next to an actual, full-size, oil or gas fired package-type steam generator exhibited at the Power Show by his company





At Flexonics Corp. (l to r) Robert W. Wilson, advertising manager, demonstrates his product to Walter E. Morton, Russell T. Gray Advertising Agency, and A. Alford of the Thermix Corp., aided by T. K. Wells, also of Flexonics

TUESDAY...

Kelvin D. Leitch and T. E. Rea, sales manager, both of the Armstrong Machine Works, before their company's show booth

(Right) Alfred Street, advertising director, Frank R. Holmsen and Wm. W. Bridgman, Jenkins Bros. (l to r) show one of their valves

(Left) Paul B. LeBoeuf, advertising manager of the Hays Corp., R. H. Morris, POWER ENGINEERING, and Phil Sprague, Jr., the executive vice president of the Hays Corp.

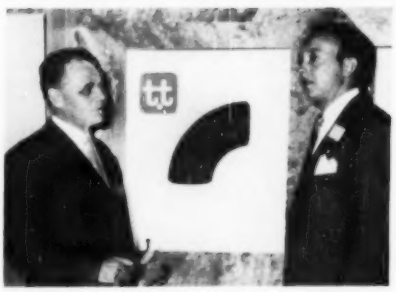
(L to r) Harry G. Smith, vice president, sales, Ohio Injector Company, stands with Harry C. Bell, also of Ohio Injector, before part of that company's display in New York City's Grand Central Palace

(Below) R. J. Felt (left) of the Niagara Blower Company explains a cut-away model of Niagara's no-frost spray cooler to P. J. Thomas of the U. S. Textile Machine Company during the Power Show

WEDNESDAY...

C. W. Ashcom, J. G. Goodwillie, A. O. Smith Corp. and W. Painter, POWER ENGINEERING

ARTERIES of the power plant and the industrial plant are the pipe lines and valves that transmit steam, water, compressed air to the required locations, and the electric conductors, switches and control equipment that supply electricity from the industrial or utility power plant. Many exhibits showed this piping and valve equipment, also the pumps, compressors, blowers and other apparatus for handling liquids and gases. Electric wiring, switches and control devices were displayed in many booths.



(L to r) Gene Wedereit and H. K. Hill, Jr., both of Tube Turns, Inc., are engaged in a serious discussion

(L to r) M. M. Fried, Joe McCaulley and George Joseph, all of the Ridge Tool Co., at show

At the luncheon of the Industrial Instruments and Regulators Div. of ASME, W. G. Brombacker, National Bureau of Standards, presents honors plaque to Albert F. Sperry, president, Panellit, Inc., for his achievements in automatic control development

(L to r) J. C. Tracy, J. H. Wahl, sales manager, W. G. Klein and P. Robbins, all of the Chapman Valve Manufacturing Co., stand next to a large valve on display in Chapman's booth during the exhibit

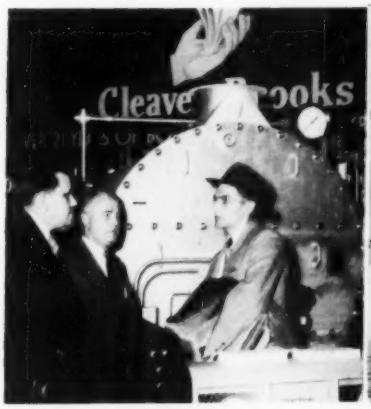
(Below) Robert W. Atkinson and W. Thomas Campbell of the Dampney Company inspect their company's large, lighted display board for selecting proper coatings for maintenance of metal in plants

THURSDAY...

SEVERAL exhibits of feedwater level and regulating equipment, including new types brought out this year, interested the visitors. Water columns and accessories of various types were shown. One booth exhibited a new model of the power-operated safety or pressure relief valve for boiler service. Gaskets, packing, and fabricated piping and valves for conditions up to 2500 psi were shown.

New types of packing, packless joints, rotating joints for piping and industrial equipment were shown. Gears, belting, variable speed transmission equipment were demonstrated. Machine tools and maintenance tools and methods, with new features of compactness, speed control, were of interest. There were many forms of heat exchangers, their tubing and other components. Chemical cleaning of boilers and heat exchangers, to save time and clean inaccessible parts, as well as the standard mechanical cleaning methods, were displayed.

(Below) B. R. Bristol and D. Robert Yarnall, president, of the Yarnall-Waring Company stand next to some of the exhibits displayed by their company



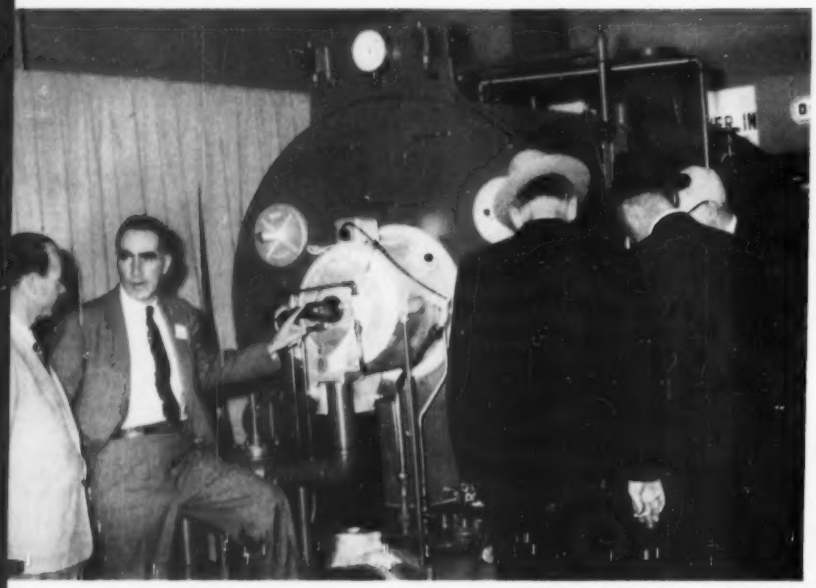
(L to r) Harold Haltz, sales manager for the Cleaver-Brooks Co., J. G. Brooks of the J. G. Brooks Co., and N. B. Post, Lederle Laboratories, discuss package-type steam generators

(L to r) Mort Serrell and Fred Schaub, president, both of the Fred H. Schaub Engineering Company, in their company's booth at National Power Show, Grand Central Palace

E. J. Bookout, sales manager of Cochrane Corp., taking look at the show

FRIDAY . . .

(L to r) J. K. Salisbury, Thermal Power Div. manager, General Engineering Lab, GE, Fred W. Argue, Stone & Webster Corp., and H. Weisberg, PSE&G Co. of N. J.



Visiting engineers listen as J. F. Keeler, vice president in charge of sales for Orr & Sembower, Inc. (second from left), points out features of package unit

D. C. Watt (left), of the Ideal Electric and Manufacturing Company, asks a question of R. Whitehill, Clark Controller Company, at Clark's booth at the Power Show

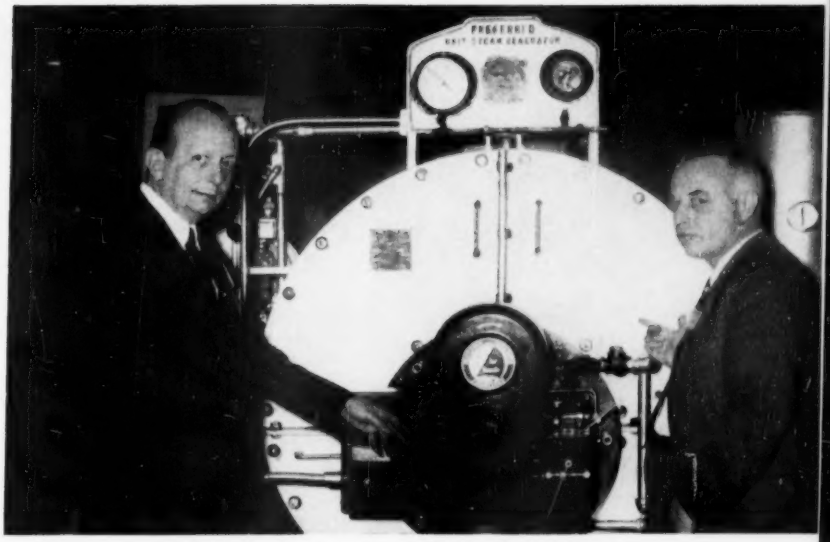
Benjamin Mills, Jr., president of the Mills Engineering Company, chats with Frederick W. Walker, president of Philadelphia Gear Works, at the latter's exhibit

(Right) H. R. Fosnot, assistant sales manager and advertising manager of the Graver Water Conditioning Company, at his company's show booth

(Left) E. B. Bossart (left), advertising manager, Bailey Meter Co., shows G. S. Carrick, *Combustion* magazine, working parts of a meter

(Right) G. C. Smith, Fred Riggan, and B. R. Braznell (l to r), Key Co., at the booth of the Key Co. and the J. Faessler Mfg. Company

(L to r) R. F. Kleinfeldt, C. A. Rieser and Bruce Wilson, all of the Pulverizing Machinery Company, in a happy moment in front of their exhibit

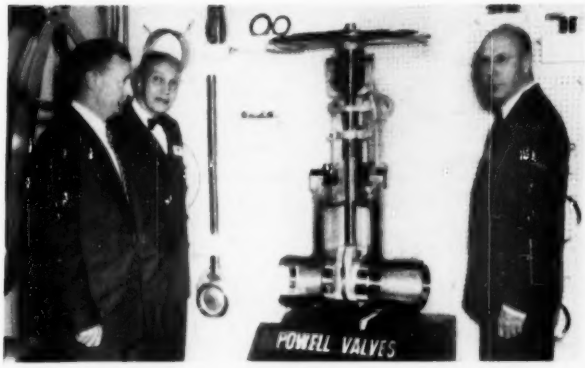


At the booth of Preferred Utilities Mfg. Corp., R. S. Bohn (left), president, and D. E. Hawk, also of Preferred, discuss details of their unit steam generator

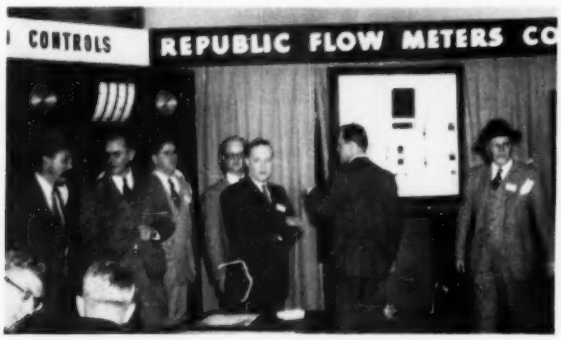
(L to r) Don Allshouse, advertising mgr., Geo. L Davis, president, and Wm. L. Hunter, vice president, Copes-Vulcan, at Taylor Instrument Co. booth

SATURDAY...

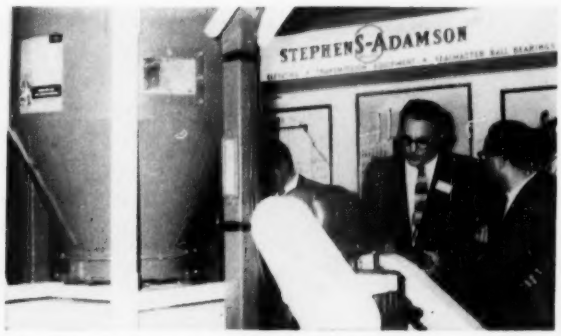
In the V. D. Anderson Company booth at the Power Show, W. J. Gleason, Jr. (left) and R. J. Grill take time out from greeting hundreds of engineers



(L to r) Vincent F. Brennon, W. E. Heilig, vice president, and M. G. Bolinger a of Wm. Powell Co. grouped around cutaway of large valve which was one of the featured displays at their company's booth during the National Power Show



The Republic Flow Meters Company's booth was crowded with people at this moment, including James D. Cunningham (far right), president of the company



R. G. Zilly (left), advertising dept. of Stephens-Adamson Manufacturing Company, explains workings of equipment to R. J. Waxman, Remington Rand Co.

THE WEEK . . .

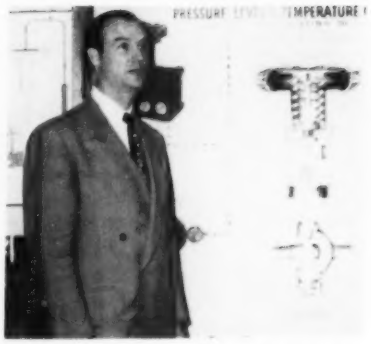
(L to r) Norman M. Godfrey, E. A. Morphett, and C. L. Frost, of Hewitt-Robins, Inc., going over details in literature on their conveying equipment before the Hewitt-Robins display booth at the 20th National Power Show in Grand Central Palace

FEATURES of the Power Show were the increased and more effective use of color and action in the display booths, and the exhibition of actual full-size equipment. There were units such as a full-sized car shake-out for unloading coal cars; full-sized automatic combustion control consoles and control equipment; large valves for steam conditions up to 2350 psi, 1100 F; complete package steam generating units; electric motors in profusion, with controls; rotary-type air compressors and fans and blowers.

Many exhibitors had very attractive animated color diagrams showing the operating details of their equipment. Many of them also displayed working models of their equipment, some in transparent cases for observation.

Several booths exhibited models of complete power plants, including a model of the complete St. Clair Station, now under construction by the Detroit Edison Co., on display at POWER ENGINEERING's booth No. 12. Here also was shown a model of the Hero steam turbine, 120 B.C., first known turbine and also the first known jet — progenitor of our present-day power plant developments.

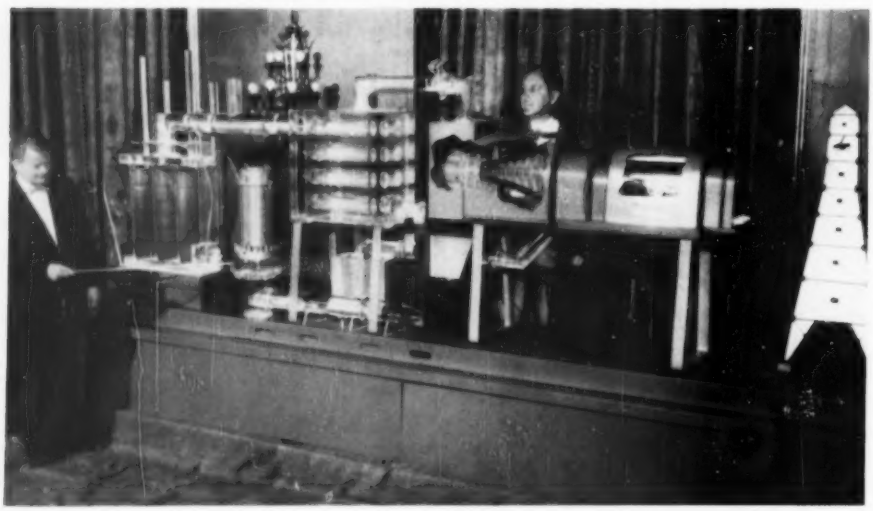
At the annual meeting of the National Association of Manufacturers, one entire session was devoted to atomic power possibilities for industry. Leading nuclear scientists and AEC representatives gave the industrialists much valuable comment on industrial uses of nuclear fission, both in generating power and in producing and utilizing fission by-products in industry. They also displayed a model of a suggested industrial atomic energy plant.



Russ Boettiger, sales manager for the Leslie Company, exhibiting an attractive, color diagram showing operation and application of his company's pressure, level and temperature controllers in Leslie's display booth at the National Power Show

(L to r) C. E. Klamm and S. E. Voran, adv. mgr., Parker Appliance Co show Donald Brady, Whitehead Metal Products, fittings and valves made by their company and methods of installing them in Parker Appliance's display booth at Power Show

Irvin V. Falk, vice president of the Reeves Pulley Company of New York, Inc., stands beside a model of the company's variable-speed transmission equipment which is mounted in a plastic case for easy observation of its construction and operation



Charles H. Weaver (left), manager Westinghouse Atomic Power Division, and Dr. W. E. Shoupp, director of development, display this model of a suggested atomic power plant suitable for industrial use. They exhibited it at a session on atomic power for industry at the 57th Annual Congress of American Industry, sponsored by the National Association of Manufacturers in New York during the week of December 1 to 6. In the model the rectangular structure at the far left represents the nuclear reactor with control rods rising from its top. Heat generated in the reactor is picked up by a suitable coolant medium, which is pumped out of the reactor to a special boiler where the heat is given up to generate steam. This drives a conventional steam turbine generator supplying electricity

What They Said at the ASME . . .

At the Annual ASME Banquet the Guggenheim Medal for 40 years of aircraft pioneering was conferred on Sir Geoffrey De Havilland in absentia. It was accepted by his son, Peter (left) and Mrs. De Havilland from Dr. Hugh L. Dryden (right)

THE FEAR that electronic machinery will render human beings obsolete lies in an evaluation of man solely as a machine to perform routine tasks. It disregards the dignity of man and overlooks the complexity of the human mind that no computer can replace — Norbert Wiener.

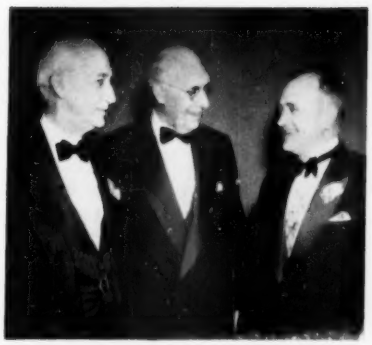
BOILERS of 1,000,000 lb per hr capacity at high temperatures can be brought on the line from cold to generation of electricity in one to two hours instead of much longer periods formerly required, with greater ease and large fuel savings, according to a detailed technical report by Jefferson C. Falkner of Consolidated Edison Co. of New York, Inc.

VAPORIZING oil burner for burning distillate fuel in a duct at a high rate, with possible boiler and gas turbine applications, was described by J. A. Johnson and R. H. Eustis.

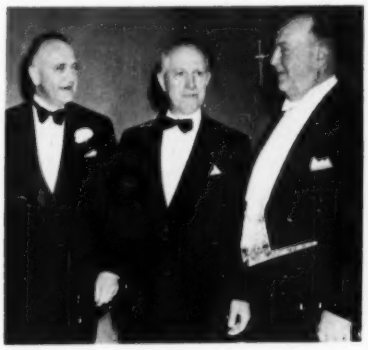
MOTION picture film as an analyzer's tool can be effective in bringing under control the labor component of materials handling costs — Wallace J. Richardson.

ENGINEERING today must consider fuels as a processing tool of more versatility than machine tools — a tool whose use . . . covers the degree of progress and stability of a technical economy — Frederic O. Hess.

FUTURE basic chemical plants modeled on the jet engine, direct conversion of solar energy, continued trend to more automatic controls, decentralization of industry were discussed by Gerard Piel.



E. G. Bailey, vice president of Babcock & Wilcox Co. (left), past president of ASME, and Frederick S. Blackall, Jr. (right), incoming 1953 ASME president, with annual banquet speaker, C. F. Kettering, research consultant, General Motors Corp.



(L to r) Frederick L. Blackall, Jr., incoming ASME president, with John M. Lessells, elected honorary member, and Nevin E. Funk, consulting engineer, formerly of Philadelphia Elec. Co., given ASME Medal for pioneering in power system operation

Frank L. Schwartz (left), assistant professor mechanical engineering, University of Michigan, presents Richards Award to Jess H. Davis, president, Stevens Institute of Technology, for outstanding achievement within 25 years after graduation

One of most important technical sessions at Annual ASME Meeting was that on Quick Starting of Large High-Pressure Boilers and Turbines under chairman G. V. Williamson (left rear), Union Electric Co. of Missouri. Principal papers presented by Jefferson C. Falkner, Consolidated Edison Co. of New York, Inc., and R. L. Reynolds, Westinghouse Electric Corp. Discussion by W. H. Rowand, Babcock & Wilcox Co., C. W. Ellston, General Electric Co., A. R. Mumford, Combustion Engineering-Superheater, Inc., A. R. Weismantle, Foster Wheeler Corp., Charles D. Wilson, Allis-Chalmers Mfg. Co. Falkner's paper gave results of extended and authoritative tests on starting boilers from cold, an increasingly important power plant operating problem. His report of successful results was outstanding

Brief cases and notebooks bulging with technical data and photographs — coat-tails flying — feet aching with the tramp-tramp-tramp from technical meeting to Power Show, to booth after booth and back again, the POWER ENGINEERING staff made a final dash for the train at Grand Central, en route back to Chicago. They also carried with them many pleasant memories of old engineering friends re-encountered, new ones made.

This special section was arranged and edited by Associate Editor Warren F. Saas from data and photographs collected by the entire staff.

The editors hope these brief flashes of the things they saw and heard will highlight for you their week in New York.

LADISH

Controlled Quality

PIPE FITTINGS

offer dependability safeguarded by advanced metallurgy

Year after year . . . in all kinds of service . . . Ladish Controlled Quality Fittings set new standards of reliability. One reason is the strong reliance on technical progress. Every new facility and advanced technique of modern metallurgy is fully utilized to develop desirable physical properties to maximum limits . . . while unrelenting test procedures continuously safeguard metallurgical soundness and provide users with authentic data proving the complete dependability of every Ladish Fitting.

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THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED UNDER ONE ROOF . . . ONE RESPONSIBILITY

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District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul
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Freedom to Sell it Vital to us All

Eight decades ago 70% of all gainful workers in the U. S. A. toiled in agriculture. Today farms and factories, put together, account for less than 40%.

Where do the rest serve? Chiefly in distribution, which includes the physical movement of products to buyers, and all forms of selling, advertising and sales promotion at the manufacturing, wholesale and retail levels, as well as the widely varied services related to the maintenance and use of American products.

With over 60% of our total labor force falling outside of farm and factory employment, obviously salesmen on the front line of selling contribute greatly to the productivity, prosperity and the world's highest standard of living enjoyed by the U. S. A.

Without sales a business fails and jobs vanish. No matter how good a product may be, it must be sold in competition with other goods. A salesman sometimes finds his products not truly competitive. He then exercises tremendous pressures on his employer for better products, lower prices, or both. Thus, competitive selling greatly influences the progress of American prosperity.

Countries where selling is inefficient, restricted or eliminated generate far less wealth, happiness and security.

Competition, especially competitive selling, is a great American Freedom. Let us preserve it to assure Progress For All Our People.

• • •

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THE COMPETITIVE SYSTEM DELIVERS THE MOST TO THE GREATEST NUMBER OF PEOPLE

BRIDGEPORT BRASS COMPANY
CONDENSER AND HEAT EXCHANGER TUBE EDITION

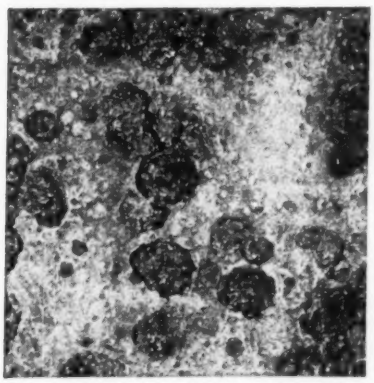
COPPER ALLOY BULLETIN

"Bridgeport" BRASS CO. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL

Dezincification of Brass

Dezincification is a type of corrosion which may occur under prolonged exposure to certain moist or wet conditions in copper-zinc alloys (brasses), containing less than 85% copper and generally in the absence of a dezincification inhibitor. Zinc is lost from the brass leaving as a residue, or by a process of redeposition, a zinc-free mass of copper with little mechanical strength.

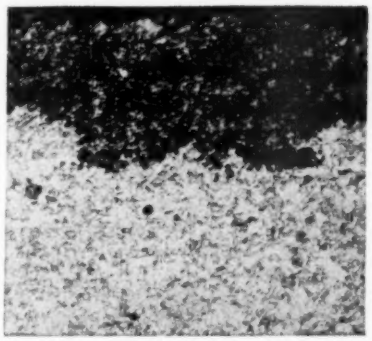
Plug-Type Dezincification may occur in highly localized areas and may be as small as pin heads. If the brass can be bent, the porous plugs of copper will pop out leaving hemispherical pits. Frequently, "plug-type dezincification" is located through the white, brown, tan, or colored tubercles or caps of zinc-rich salts which form over the areas wherein dezincification has occurred.



Porous plugs of copper which are deposited in "plug-type dezincification" of non-inhibited aluminum brass tube which was flattened out and photographed. Note overlapping of plugs. Micrograph mag. 10X.

Layer-type Dezincification covers larger areas instead of individual plugs. Sometimes it results from a merging together of a large number of small plugs of copper and can be recognized by the rounded nodular appearance of the copper layer which is adjacent to the brass surface. After a long period of time relatively thick layers (.003" or more in thickness) may be peeled off leaving an irregular surface.

"Layer-type dezincification" may occur on brass with or without a dezincification inhibitor under conditions where severe general corrosion results in the formation of a thick layer of corrosion products. Decomposition of the copper salts in the corrosion products can occur through reversal of the corrosion cell and crystals of copper are deposited which are comparatively large, bright and dense.



"Layer-type dezincification" is recognized by relatively thick layers of deposited copper built up over a period of time. Micrograph mag. 75X.

Intercrystalline Dezincification may occur preferentially along the grain boundaries. This may weaken the metal due to the brittleness of the intercrystalline deposit of copper and poor adhesion to the surfaces of the grains of brass.

Intercrystalline dezincification along grain boundaries. Micrograph mag. 250X.

Beta Phase Attack. In the two phase alloys (Alpha and Beta) such as Muntz or Naval brasses which contain about 60% copper and between 39 and 40% zinc, dezincification may be concentrated initially on the Beta phase and may be sufficient to weaken the metal. If the attack spreads to both Alpha and Beta phases, complete dezincification may result with the formation of a layer of porous copper which can be peeled from the surface of the brass.

Retarding Dezincification

Since certain deposits of either corrosion products or porous materials may set up corrosion cells which initiate dezincification in brass, the prevention of such deposits from attaching themselves to the metal surface will help reduce dezincification. Consequently, dezincification can be retarded by mechanical or chemical cleaning or by a sufficiently high or turbulent flow which will discourage the settling of deposits on the metal surface. Dezincification can be retarded or prevented by using inhibited alloys such as Arsenical Admiralty (30) and Arsenical Aluminum Brass (54). This subject will be discussed in a later issue of the Copper Alloy Bulletin.

Effect of Protective Scales. Certain waters which have deposited magnesium silicate or silica scales or coatings on brass surfaces are without effect on the brass. Under such conditions these silica or silicate scales are completely protective to the underlying metal and the alloy may last indefinitely. Dense adherent calcium carbonate scales are also effective in reducing or preventing dezincification but if too thick, they will cut down the heat transfer rate of the metal.

Laboratory Service

Condenser and heat exchanger tubes are made from alloys, that are primarily designed to withstand the attack of corrosive sea water or fresh water, clean or polluted; petroleum liquids and gases, chemicals, fatty acids, foods, sugar solutions, and various other gases and liquids. They have excellent heat transfer properties.

Bridgeport's research work includes investigations dealing with the behavior of metals and alloys. Please contact the nearest Bridgeport office about your condenser tube problems and requirements. (9196)

For more data circle 512 on Post Card

14 YEARS

of operating experience with STEAM

OVER 2000 PSI

An important element in successful high-pressure operation is the B&W Cyclone Steam Separator, developed by B&W Research. This simple, highly efficient device is typical of the manner in which B&W's progressive research pushes the science of steam generation to ever higher levels of economy.

For those seeking the high steam-cycle efficiencies obtainable with steam pressures over 2000 psi, B&W offers unparalleled design and operating experience . . . drawing upon a background extending over the last 14 years with units to-serve over 10,000,000 kilowatts of generating capacity.

The outstanding performance records of the 14 B&W installations already operating in this range have given strong impetus to the present trend toward use of pressures over 2000 psi . . . have resulted in orders for more than 60 additional B&W units with design pressures up to 2700 psi.

B&W's many years of experience in designing and building boilers for economical, high-pressure steam generation, as exemplified in the list on the opposite page, are at your service.

G-585T

B&W BOILERS WITH DESIGN PRESSURES OVER 2000 PSI

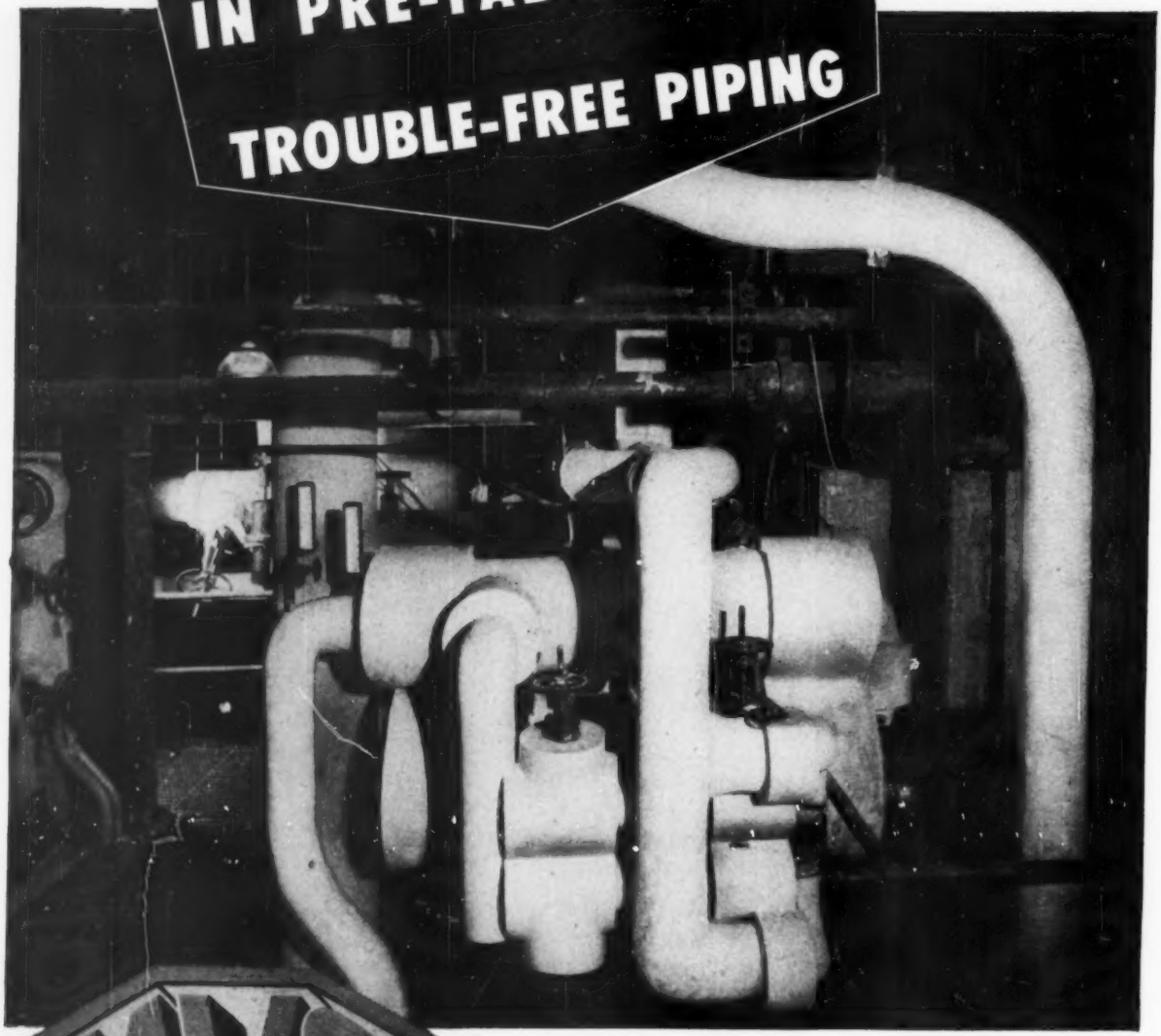
Owner	Boiler Design Pressure
Diamond Alkali Co.	2200
Indiana & Michigan Electric Co.	2650
Appalachian Electric Power Co.	2300
Indiana & Michigan Electric Co.	2300
The Ohio Power Co.	2300
Commonwealth Edison Co.	2125
Indiana & Michigan Electric Co.	2300
Appalachian Electric Power Co.	2300
Commonwealth Edison Co.	2125
The Ohio Power Co.	2300
Public Service Co. of No. Illinois	2050
Indiana & Michigan Electric Co.	2300
Consolidated Edison Co. of N. Y.	2050
Philadelphia Electric Co.	2075
Consolidated Edison Co. of N. Y.	2050
Pennsylvania Electric Co.	2080
Philadelphia Electric Co.	2075
Detroit Edison Co.	2050
Appalachian Electric Power Co.	2400
Commonwealth Edison Co.	2125
Tennessee Valley Authority	2050
Commonwealth Edison Co.	2125
Detroit Edison Co.	2050
Jersey Central Power & Light Co.	2225
Georgia Power Co.	2100
Southern California Edison Co.	2050
Narragansett Electric Lighting Co.	2350
Public Service Co. of No. Illinois	2125
Tennessee Valley Authority	2050
Ohio Edison Co.	2300
Pacific Gas & Electric	2050
Public Service Elec. & Gas	2700
Indiana & Michigan Electric Co.	2400
Tennessee Valley Authority	2050
Tennessee Valley Authority	2050
Tennessee Valley Authority	2050
The Ohio Power Co.	2400
The Ohio Power Co.	2400
Ohio Edison Co.	2300
Consolidated Gas Electric Light & Power Co.	2075
Ohio Valley Electric Corp.	2400

TOTAL GENERATING CAPACITY SERVED: OVER 10,000,000 KILOWATTS

BABCOCK & WILCOX

For more data circle 513 on Post Card

NAVCO ACCURACY IN PRE-FABRICATION TROUBLE-FREE PIPING



NAVCO

Prefabrication accuracy is an essential "MUST" to assure a proper fit and economical operation. Navco's 40 years' experience in fabricating assemblies in all sizes and for all operating conditions is your assurance of such accuracy.

Consult Navco for your next piping job.

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

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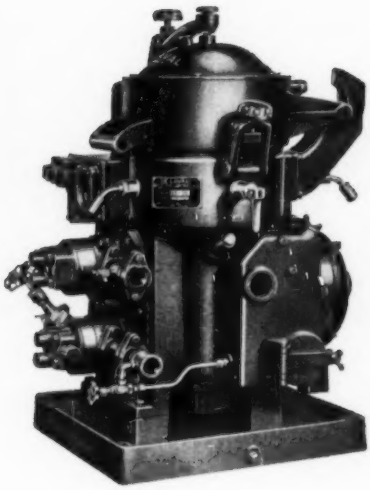
For more data circle 514 on Post Card



There's no dodging it—turbines require protection from two different causes of lubrication failure—***dirt*** and ***water.*** Removal of dirt alone does only half a job. That is why De Laval Oil Purifiers are so much more effective for maintaining turbine oil than any other means available. They instantaneously remove solid foreign matter and also any moisture that may be present.

It is extremely important to get ***double protection*** when you purify turbine oil, for water is the real trouble maker as often as not. For example, condensate in oil leads directly to the formation of sludge, and of course there is always the possibility of a major water leak which might lead to serious emulsification and very real trouble.

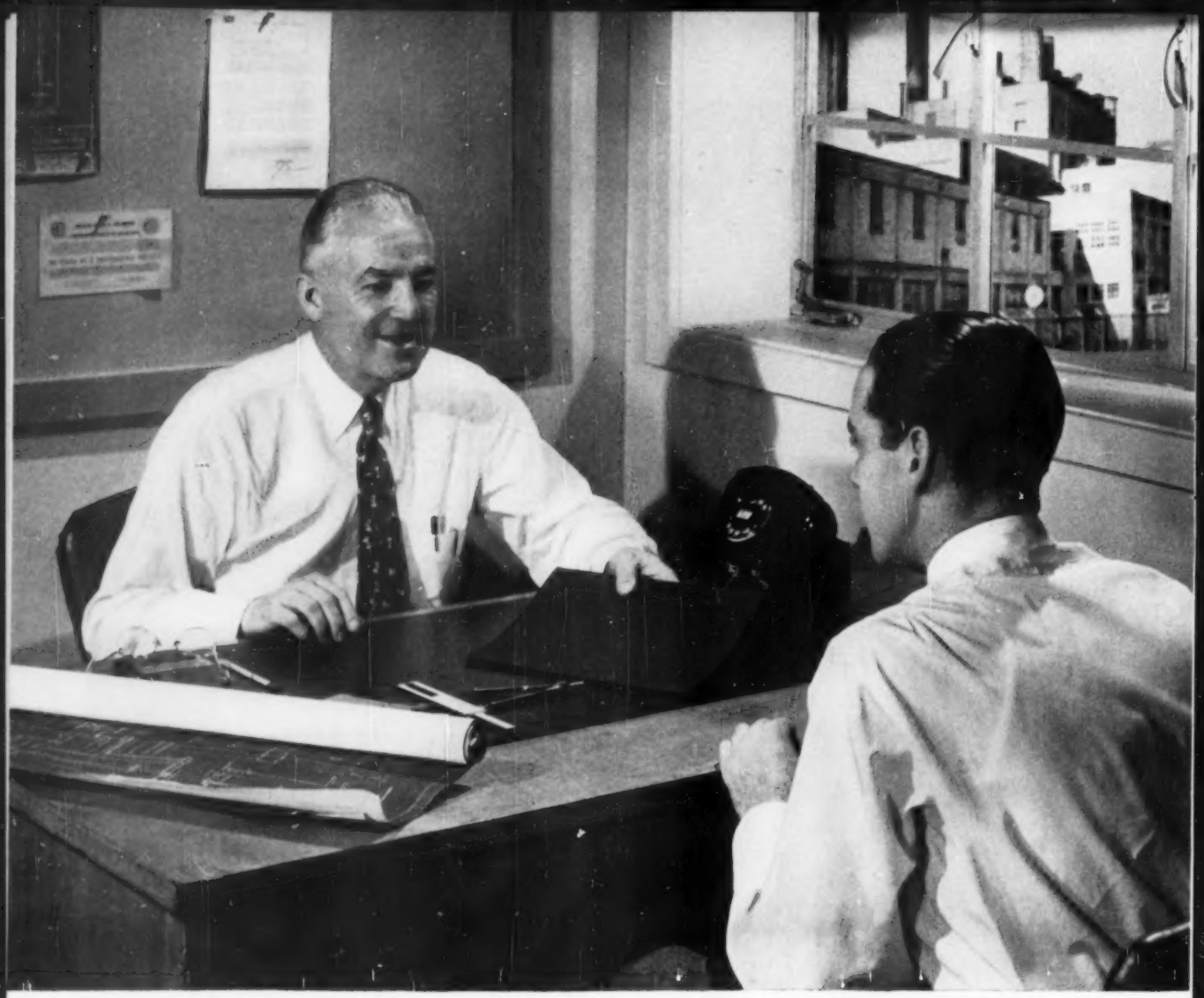
De Laval Oil Purifiers do not remove oil-soluble additives; action within the centrifuge is entirely mechanical.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO. 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited Peterborough, Ont.

DE LAVAL

LUBRICATING OIL PURIFIERS

For more data circle 515 on Post Card



When you have a water conditioning problem—the first thing to do is call

cochrane

Whether your requirements are large or small, call a Cochrane Water Engineer. Supported by his recommendation, you'll be sure you're right.

. . . water conditioning is a problem for specialists. The Cochrane people specialize in water engineering and water conditioning equipment. And since Cochrane manufactures all types of water treating equipment their recommendations are unbiased. Cochrane engineers will show you how to obtain most economically the quality of water you want. Call Cochrane first when you have a water conditioning problem.

THERE'S A COCHRANE SOFTENING PROCESS TO GIVE YOU THE WATER YOU WANT

When you have a water softening problem—Cochrane Water Engineers can give you the right answer. Through many years of experience in all types of water treatment—including ion exchange—Cochrane offers five distinct processes, each with specific advantages for a particular job:

Hot Zeolite Process
Sodium Zeolite
Hydrogen Zeolite
Dealkalization
Demineralization

A Cochrane Water Engineer will be glad to explain the differences in these processes. He'll show you how the one process best suited to your requirements will provide water of the quality you want, cheaply and abundantly—from any raw water.

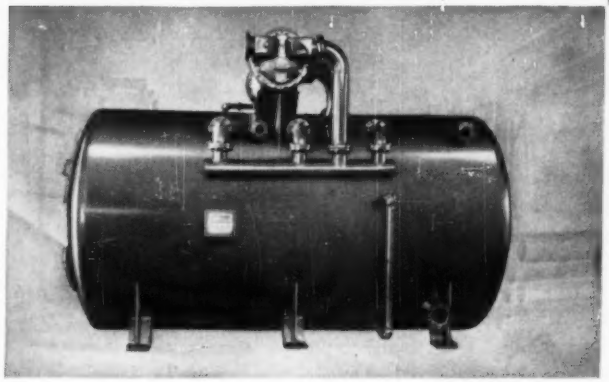
COMPLETE DEAERATION OF BOILER FEEDWATER

Cochrane provides all types of Deaerators to meet any requirements:

Tray-Type Deaerators
Atomizing Deaerators
Deaerating Hot Water Generators
Cold Water Deaerators

One of these units can be applied to your particular boiler feedwater requirements and built of materials suited to your service. A Cochrane Water Engineer will bring you the benefit of Cochrane's long experience in conditioning boiler feedwater.

Cochrane Zeolite Softener installed with a HYDROMATIC Single Control Valve.



Cochrane Tray-Type Deaerator for Central Station installation in the Southwest.

Cochrane equipment covers the full range of water conditioning:

HOT PROCESS SOFTENERS
HOT AND COLD ZEOLITE SOFTENERS
DEAERATORS & OPEN HEATERS DEMINERALIZERS
DEALKALIZERS DEGASIFIERS
REACTORS & CLARIFIERS
CONTINUOUS BLOWOFF SYSTEMS
STEAM SPECIALTIES CONDENSATE RETURN SYSTEMS

To give you prompt consultation and service, Cochrane Water Engineers are strategically located in 29 cities throughout the United States. Write today for the address of our office nearest you.

COCHRANE CORPORATION
WATER ENGINEERS FOR 90 YEARS
1863 - 1953

cochrane

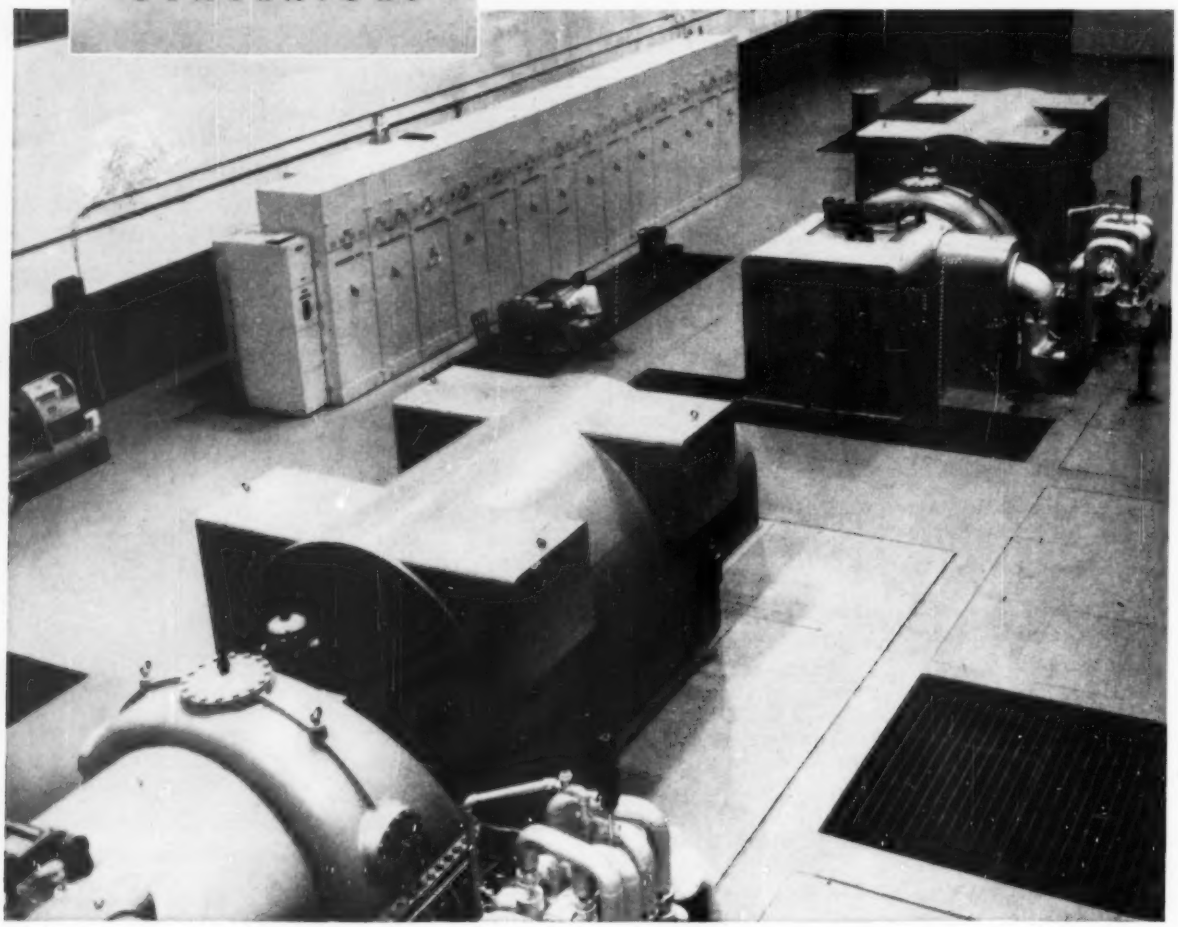
corp. 3123 N. 17TH STREET, PHILADELPHIA 32, PA.

In Canada: Canadian General Electric Co., Ltd., Toronto
In Mexico: Babcock & Wilcox de Mexico, S.A., Mexico City
In Europe: Recuperation Thermique & Epuration, Paris

For more data circle 516 on Post Card

DE LAVAL TURBINE GENERATORS

provide more power for Guam



De Laval furnished the Navy Department, Bureau of Yards and Docks, two 11,500 kw De Laval Turbine Generators to supplement power requirements for the island of Guam, headquarters for ship repairs and defense activities in the Pacific. These AIEE-ASME Standard Units operate at 600 psi, 825F. They have been on the job more than a year. Service record? Excellent.

More than a half century of experience lies behind modern De Laval Turbine Generators. In fact, the first unit of this type ever installed in America—in *1893*—had a De Laval nameplate. De Laval engineers are old hands at making turbines that are high on performance, low on maintenance.

You benefit by De Laval's quality design standards in a wide range of other power plant products—boiler feed pumps, IMO fuel oil pumps, circulating water pumps and condensate pumps. Consult your De Laval Engineer on your specific applications.

DE LAVAL *Turbine Generators*

DE LAVAL STEAM TURBINE COMPANY
816 Nottingham Way, Trenton 2, New Jersey

DL-152

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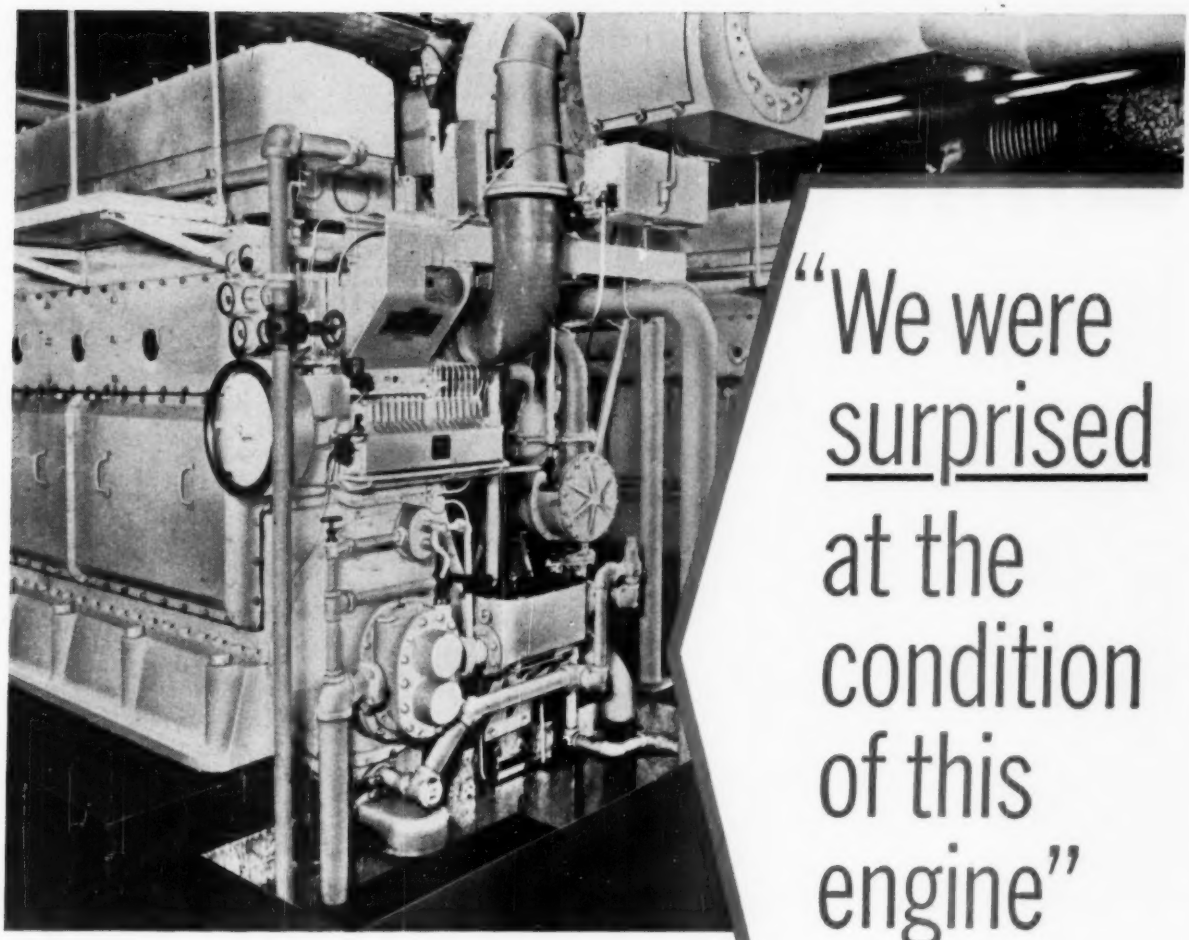

"We were surprised at the condition of this engine"

. . . says G. V. Yarger,
Supt. Municipal Utilities
Waverly, Iowa

"When we finally opened up our Worthington, it was in the *best* condition I've ever seen a diesel engine that had operated such long hours and under such heavy loads as this unit. It had a total of 48,926 hours on it – 8,987 hours of tough operation since the last overhaul.

Mr. Yarger continues, "We've been using Sinclair RUBILENE® Heavy in the crankcase and RUBILENE H.D. 30 in the cylinder lubricator. These RUBILENES have kept the crankcase and upper portions of the cylinders exceptionally clean and bright, with no sign of carbon or deposits."

That's a typical report on the exceptional qualities of the Sinclair RUBILENES . . . evidence that they could improve the efficiency of *your* diesels, too. Why not switch now? Contact your nearest Sinclair Representative or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N. Y.

SINCLAIR DIESEL OILS

save wear and replacements

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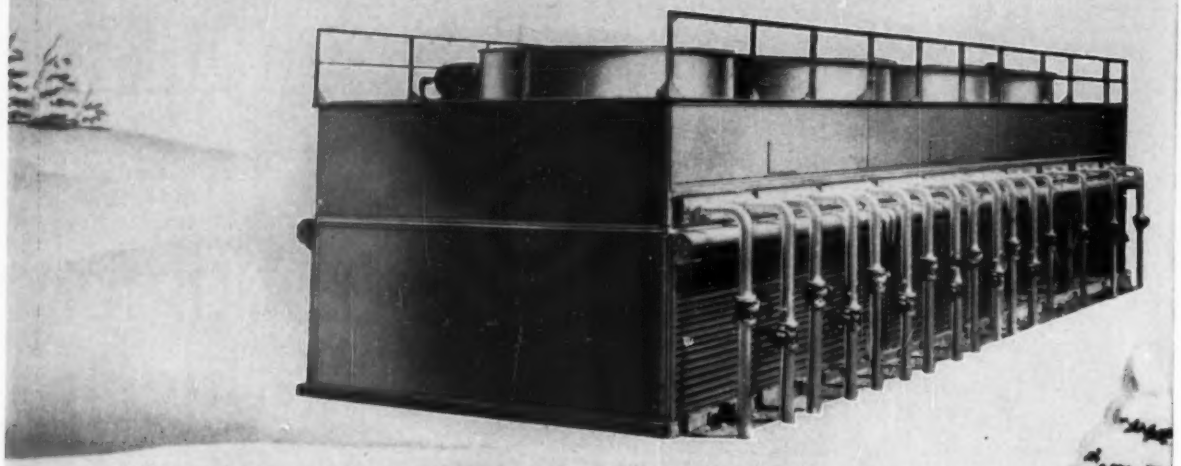
MARLEY DRICOOLERS®

take winter in stride...



Maintaining correct process temperatures in all kinds of weather . . . that is the job DriCooler air cooled heat exchangers are engineered to do and they do it! How well they do it is best attested by the experience of DriCooler operators in the Northwest and other sections of the country where sub-zero temperatures are common.

These operators know that DriCoolers in their plants are engineered for any conditions the elements offer. They know that at 30 and 40 degrees below zero there will be no days or nights of intense effort to keep plants running in spite of frozen tube sections, fan icing or other winter-caused difficulties. All have full confidence that their plants will go on delivering gas or electricity in a smooth routine manner because they have the benefit of Marley's broad experience in designing DriCoolers to meet frigid conditions.

Marley engineering gives as much consideration to low temperatures as to high temperatures. Marley uses (and uses correctly) the most modern techniques to aid the operator in maintaining design temperatures the year round. DriCooler induced draft design protects tube sections by placing them below the plenum chamber where they are not exposed. It keeps the fan in the warm air stream where it cannot accumulate ice. Add to this the control of intake air by easy rolling steel doors or by multi-vane shutters and you have the one air cooled heat exchanger that knows no climatic barriers . . . you have the Marley DriCooler.

Write for a copy of this brochure. It gives very complete information on application of DriCoolers in YOUR business. Address Department DC2.

MARLEY

The Marley Company

Kansas City 5, Missouri

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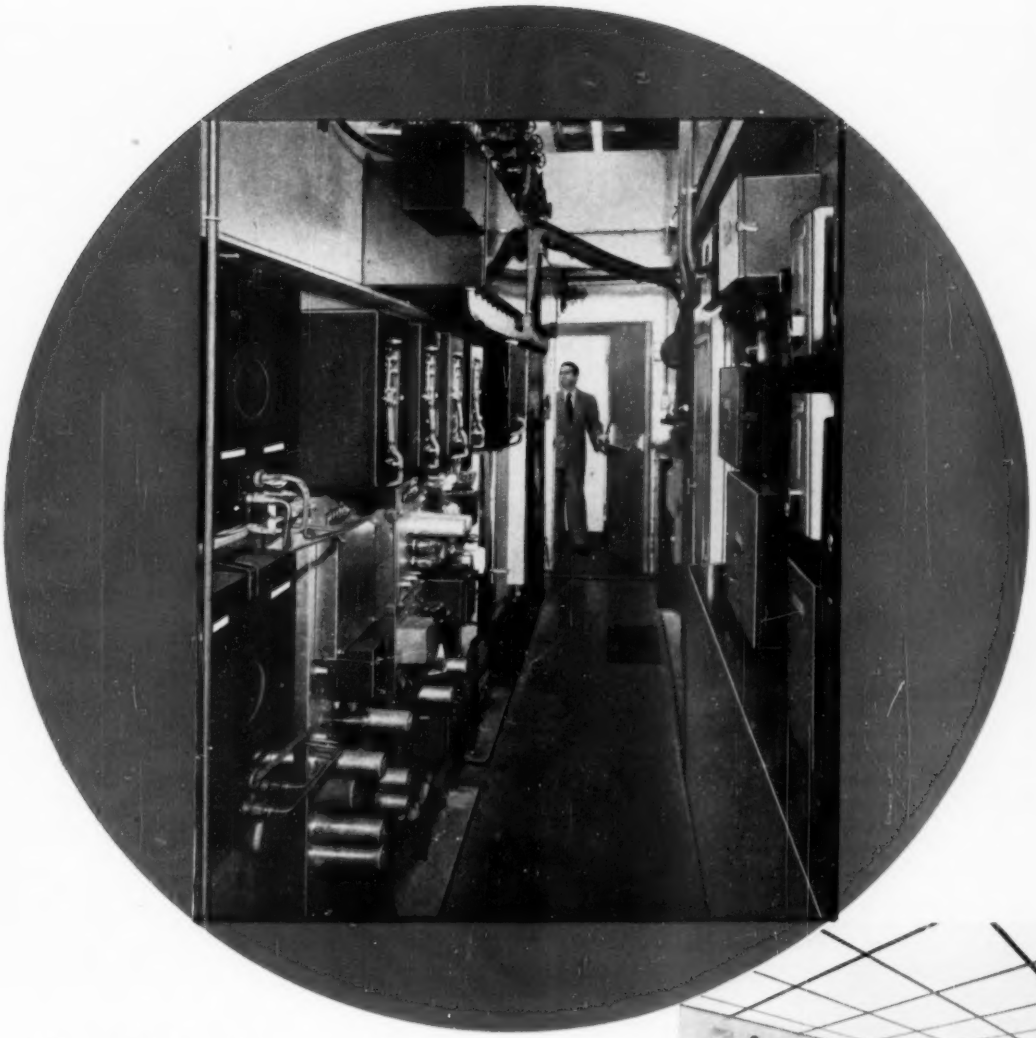
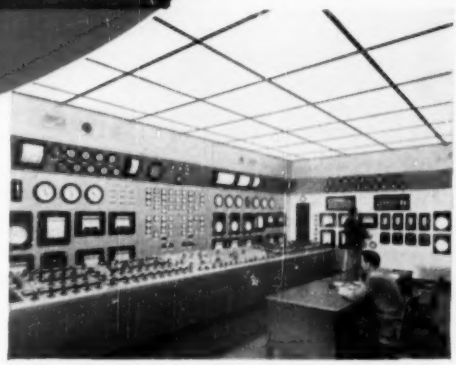


walk inside this control panelboard ...prefabricated by PANELLIT

You will find many new and unique features of engineering and construction in recently installed power station control systems . . . built by PANELLIT.

On every installation, excellence in fabrication and finish on the panel front is only exceeded by the ingenious behind-the-panel engineering for which PANELLIT is well-known. This engineering foresight assures the long-term serviceability of your entire control system. It will be recognized and appreciated for years to come by those responsible for maintenance and service.

PANELLIT maintains a separate Power Division with engineers specifically experienced in the design and installation of controls for the Power Industry. And, since PANELLIT is not an instrument manufacturer, it can be completely unbiased with respect to engineering assistance as well as the selection of controls for each phase of your system.



BRIEF FACTS ABOUT THIS INSTALLATION

Installation shown is the Central Control Room at the Edge Moor Station of the Delaware Power and Light Company, engineered and installed by United Engineers and Constructors, Inc., Philadelphia, Pa.

Prefabricated entirely by Panellit, Inc., the four-wall control panel forms the control room. An inner wall is the control panel front on which the instruments are mounted, the insulated outer wall serves as the outside wall of the control room and holds all contactors and electronic equipment associated with the combustion control.

LITERATURE WILL BE SENT UPON REQUEST.

PANELLIT, INC.

General Offices: 6312 North Broadway
Chicago 40, Illinois

PANELLIT

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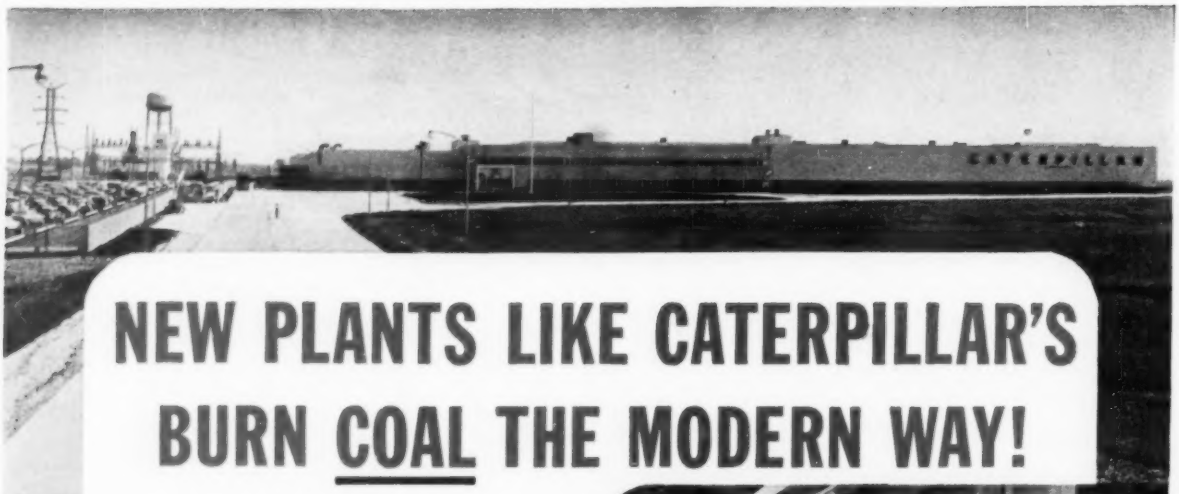
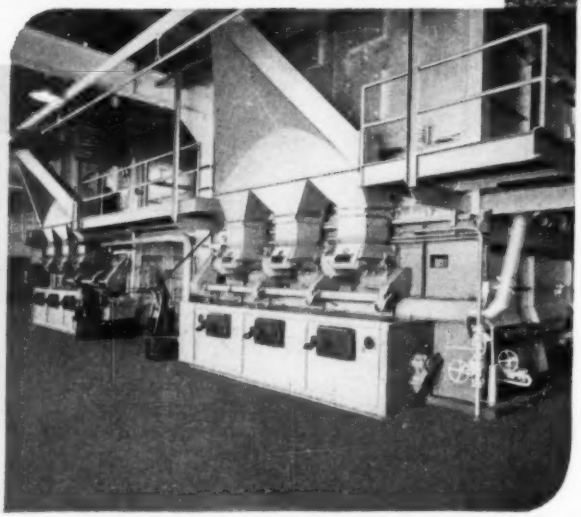


NEW PLANTS LIKE CATERPILLAR'S BURN COAL THE MODERN WAY!

Mr. R. H. Bachman,
Plant Maintenance Engineer,
Caterpillar Tractor Co., says:

"Our new plant pictured above was recently completed at Joliet, Illinois. A completely up-to-date coal installation was chosen to handle the heat and process steam requirements. To the right is a picture of the firing aisle showing how the boilers are fed by dust-tight chutes from overhead bunkers. This modern equipment makes coal as clean, convenient, and efficient as a fuel can be! The boilers are rated at 80,000 lbs. of steam per hour, but have handled loads as low as 3,000 lbs. per hour without difficulty."



For big savings, build for COAL! That's a good rule to follow whether you've got a new plant under construction or an older plant being modernized.

Up-to-date coal-burning equipment can give you more steam per dollar . . . modern coal- and ash-handling systems can cut labor costs to a minimum. In addition, coal is the only fuel with virtually inexhaustible reserves. And to mine this coal, to better prepare it for customers' special needs, America has the world's most productive coal industry. Thus, coal users get a double advantage—*dependable supply of an even better product, at relatively more stable prices.*

For heat, power, process steam—coal is your best bet! Ask a consulting engineer. He'll show you how to cut both fuel and operating costs by burning coal in a modern plant designed to meet your specific needs.

If you operate a steam plant, you can't afford to ignore these facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—*for hundreds of years to come.*

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

BITUMINOUS COAL INSTITUTE

A Department of National Coal Association, Washington, D. C.

FOR HIGH EFFICIENCY FOR LOW COST

YOU CAN COUNT ON COAL!

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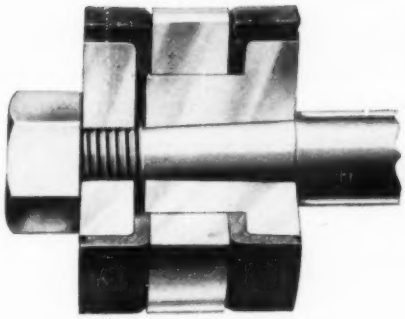
New Garlock Molded Cups Folder describes in detail our complete line of cups. Write for your copy today! ▸

GARLOCK MOLDED CUPS

For Pump Pistons, Hydraulic Service, Pneumatic Equipment



Garlock Cups for Pump Pistons are available for standard cylinder sizes.

A COMPLETE LINE OF CUPS FOR INDUSTRIAL USE

GARLOCK Molded Packing Cups are made from the highest grade materials to rigid specifications for *long, trouble-free service.* These cups are made in many types and styles, each designed and constructed for a specific service condition.

BITAN* Leather Cups, available for practically any cylinder diameter size, are recommended for use against cold and hot water, oils, gases, and solvents. For hot oil service up to 250° F., specify synthetic-rubber-impregnated Bitan leather cups.

Rubber and Synthetic Rubber Cups with fabric insertion are made in a wide range of material combinations for cylinder diameters from less than ½" up to and including 16". For service against air at high or low pressures, against oils, and on heavy duty hydraulic equipment.

Start cutting maintenance and replacement costs now—standardize on Garlock Molded Cups.

*Registered Trademark

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK

PACKINGS, GASKETS, OIL SEALS, MECHANICAL SEALS, RUBBER EXPANSION JOINTS

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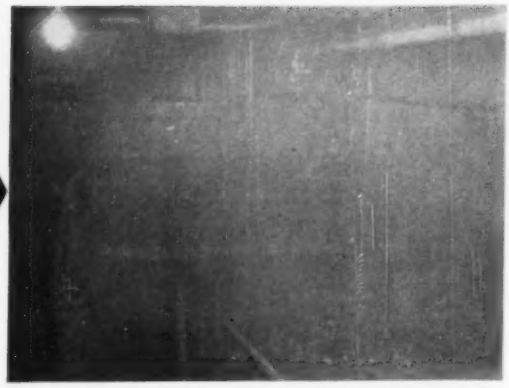
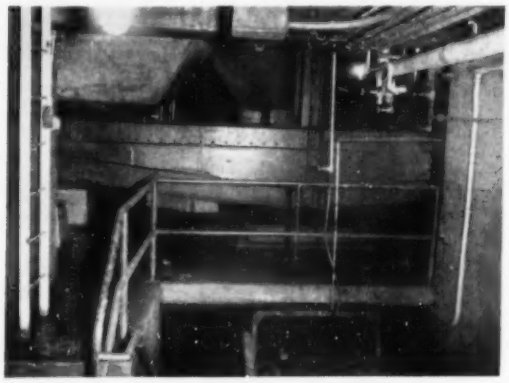
STOP COAL DUST

for 1/10 Usual Cost

at car dumpers, hoppers, crushers, belt galleries, and coal piles



BEFORE — Reciprocating feeder and belt housing in operation at large Illinois utility with Johnson-March System turned off.



AFTER — The same operation taken with the Johnson-March System turned on. Note complete absence of dust. Name of utility will be gladly furnished upon request.

● The Johnson-March Dust Control System *stops dust before it becomes airborne!* And it does it *without expensive ducts, fans and other cumbersome equipment!*

Hundreds of J-M installations daily stop dust efficiently and economically at such sources as car dumpers, hoppers, crushers, belt galleries and coal piles.

Cost of this positive dust control system averages less than 1/10 the cost of other methods. Maintenance costs are next to nothing. Installation is fast, simple and inexpensive. There is no interference with normal plant operations.

Our engineers will be glad to discuss this positive, low-cost system at no obligation. Write today for detailed information.

Johnson March

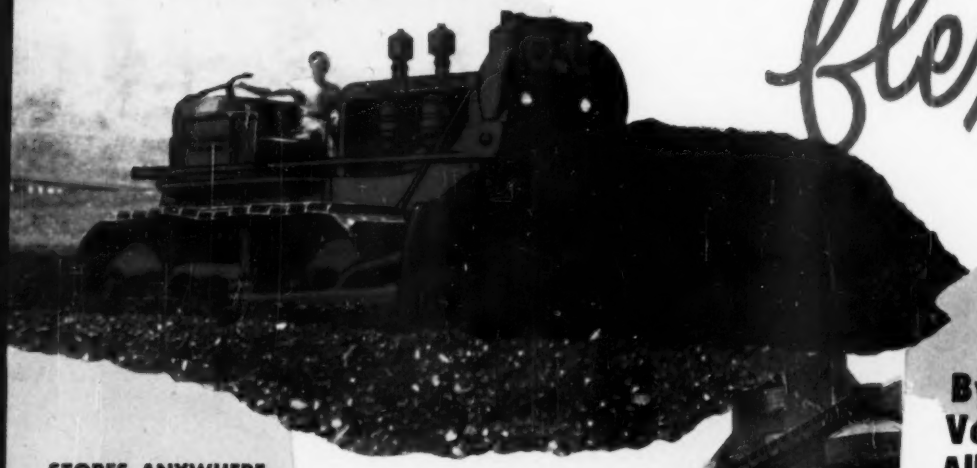
Specialists in Dust Control

Dept. PE-5 1724 CHESTNUT ST. Philadelphia 3, Pa.

For more data circle 523 on Post Card

MAKE COAL HANDLING *flexible*

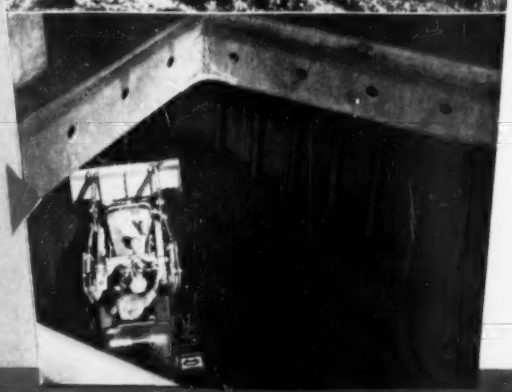
MOVES AND COMPACTS COAL — Allis-Chalmers torque converter tractor with Gar Wood dozer moves coal up to 750 ft. from crusher chute out over storage pile at Georgia Power Co. plant near Macon, Ga. The 41,000 lb. tractor compacts the coal to eliminate danger of combustion.



STORES ANYWHERE, RECLAIMS AS NEEDED — Handling coal with four A-C Tractors and Gar Wood scrapers permits placing storage piles wherever there is available space around the Miami Fort plant of The Cincinnati Gas & Electric Co. Coal is hauled up to 1700 ft., spread in thin layers and compacted. The self-loading scrapers efficiently haul coal as needed to reclaiming hopper.

STOCKPILES — HD-5G Tracto-Shovel stockpiles coal as it is unloaded from railroad cars at Crown Cork and Seal Co., Baltimore, Md. Also used to load into trucks.

HELPS UNLOAD — Canada Cement Co., Montreal, uses HD-5G Tracto-Shovel with dozer to pull coal and cement from sides and ends of ship hold into reach of crane bucket. Eliminates hand shoveling, speeds up unloading.



By Using Versatile Allis-Chalmers Tractors *you can*

- Handle *all* of your coal storing and reclaiming — or supplement existing facilities.
- Add storage areas anywhere without installing costly conveyors, tracks, etc. — or abandon them without leaving money tied up in idle equipment.
- Speed up handling during rush periods by adding more tractor units.
- Quickly change storage system or methods... crawler tractors work free of rails and runways, make their own "roadway" anywhere!

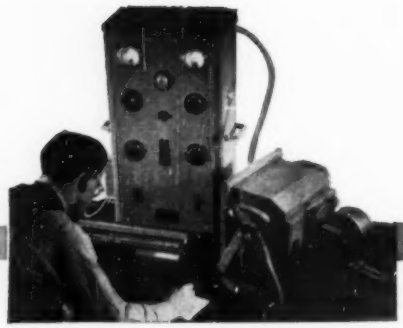
Send for free booklet, "Economic Coal Storage with Allis-Chalmers Tractors." Describes modern coal-handling methods, using A-C tractors and 'dozer blades, front-end loaders and scrapers. Write Allis-Chalmers Tractor Division.

ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

SMALL PLANTS, TOO!

CAN PROFITABLY USE THE *Nalco* SYSTEM



X-Ray equipment, used in the Nalco Laboratories as an aid toward providing positive water treatment results.

● *Water treatment service for small plants is an important part of Nalco's business.*

This indicates two things:

Small plants find Nalco Service Agreements a profitable investment . . . And

Nalco facilities and services are geared to handle — efficiently and economically — the needs of *any* plant, regardless of its size or the volume of water treatment chemicals used.

If your plant is a small one, you can get the same security from water treatment difficulties as many of the world's largest steam generating stations have with Nalco Service Agreements — and at a cost entirely in line with the size of *your* plant and your problems. Write today for complete details, or call your Nalco Representative.

NATIONAL ALUMINATE CORPORATION

6224 West 66th Place • Chicago 38, Illinois

Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario, Canada

THE *Nalco* SYSTEM . . . Serving Industry through Practical Applied Science

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Helpful Bulletins

THE ANSWERS to many of your operating and maintenance problems are found in these new and recently revised catalogs and bulletins. Circle item numbers of all catalogs wanted on the postage-free card below, detach and mail

PUMPS AND COMPRESSORS

101 Installing a Pump — Blaming many pump operating troubles on improper pump selection and installation, this 8-pp technical article tells what should be taken into consideration when ordering a pump. Titled, "Studying the Installation," it discusses head, viscosity, pipe friction, suction lifts, horsepower and materials. Illustrated with installation diagrams, includes tables of friction loss. Viking Pump Co.

102 Small Vertical Pumps — Construction features of small vertical pumps for sidewall or submerged mounting are described in Bulletin 52B6975A. Units covered are available in capacities to 250 gpm at heads to 125 ft, for coolant circulating and air conditioning. Curves and tables to determine motor frame, horsepower, speed and current characteristics are included. Allis-Chalmers Mfg. Co.

103 Vertical Pumps for Volatile Fluids — This 6-pp bulletin describes the advantages of company's vertical turbine pumps for handling gasoline, diesel fuel, crude oil, L-P gases, ammonia and other volatiles. Illustrated with cross-section drawings. Johnston Pump Co.

104 Hand Pumps — Six-pp Bulletin HP206 describes and pictures pumps of 7 to 28 gpm capacity for pumping lube oils, thinners, solvents, cutting oils and industrial liquids from drums, wheel tanks or underground storage. Also shows models used as refueling systems for power equipment, as well as mounting accessories. Blackmer Pump Co.

105 Compressor Data Book — Bulletin M-70 is a 44-pp, illustrated booklet of engineering information on manufacturer's complete line of reciprocating compressors from 100 to 5000 hp. Provides basic application data with design specifications covering the Types EM, FM and JM multi-stage and multi-cylinder units. These compressors are designed for a broad range of industrial air compressing and chemical processing operations. The Cooper-Bessemer Corp.

VALVES, TRAPS, PIPING AND ACCESSORIES

106 Compressor Valve — Bulletin 509 B describes and illustrates company's Airchek valve for discharge lines of air and gas compressors. Shows how this valve is designed to simplify an installation, to provide trouble-free service. Pennsylvania Pump & Compressor Co.

107 Compound Steam Traps — Bulletin 215, 8 pp, covers the purpose, operation, physical data, capacities, installation and prices of manufacturer's piston-operated compound traps. These traps are suggested for use on equipment producing very large amounts of condensate — purifiers, separators, evaporators, large storage type hot water heaters. Illustrated. Armstrong Machine Works.

108 Corrosion-Resistant Piping — Wood-lined steel pipe, saran rubber-lined steel pipe, and wood stave pipe and joints are described as to construction and applications in this bulletin. Also discusses light gage piping. Michigan Pipe Co.

109 Iron Pipe Identification — Five tests for the identification of wrought iron pipe are described in this small brochure. Tells why recognition of material is important. A. M. Byers Co.

110 Line Type Purifiers — Bulletin 501, 8 pp, is well illustrated and tells how company's mechanical separators save money by cleaning up steam, vapor, compressed air and gases by removing practically all dirt, solids, moisture, guck and other objectionable entrainment. Photos show equipment arrangement and blueprint drawing shows piping layouts. Includes selection tables, dimensions, capacities, prices. The V. D. Anderson Co.

111 Expansion Joint Guide — Catalog CMH-127R, 16 pp, describes all types of company's Flexon corrugated expansion joints and the basic theory behind their design. Gives specifications and installation information for the recently designed line now capable of handling more pipeline motion with fewer corrugations. Presents free-flexing expansion joints for low pressure uses, controlled-flexing joints for absorbing greater amounts of traverse, and integral-ring types for extreme high-pressure applications. Flexonics Corp.

INSTRUMENTS AND CONTROLS

112 Electronic Indicators, Recorders — Catalog 1520 contains 48 pp of factual information on company's ElectroniK non-control precision instruments which employ a potentiometer, Wheatstone bridge or other measuring circuit, to measure temperature, pressure flow, pH and many other variables. A handbook for engineers' and buyers' use, book gives detailed specifications for each model. Includes information on specially adapted instruments, such as the function plotter. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

113 Hook-On Instruments — Booklet GEC-901, 8 pp, describes manufacturer's complete line of hook-on instruments. Covers applications, operation and basic features of a hook-on type volt-ammeter, wattmeter, and power factor meter. General Electric Co.

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JANUARY, 1953

Card void in 6 months

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the numbers circled below.

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Use this space to ask for tear sheets and other information.

114 Dampers and Operators — Catalog 8502, 12 pp, describes louver, round, mixing, outlet and fire dampers for regulation of air flow in industrial applications; also electric, pneumatic and manual damper operators. Includes application data, velocity-pressure drop charts, and damper ratings for operators. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

115 Metering Applications — Twenty-pp Booklet GET-1905 describes applications for watthour meters. Contains circuit wiring diagrams for various applications. Also describes watthour-meter constants and register data, the determination of watts load, and the use of watthour meters with instrument transformers. General Electric Co.

MECHANICAL POWER TRANSMISSION

117 Speed Reducers — Catalog 45-C, 8 pp, covers manufacturer's Type S worm gear speed reducer made with a horizontal worm at bottom, worm at top or vertical drive. Gives general specifications, rating tables, dimensions and prices for the speed reducers which come in 24 sizes, in ratio ranges of 5.66 to 1 and from 0.04 to 15 hp. D. O. James Gear Mfg. Co.

118 Sheave Selector — This slide-chart selector is offered as an aid to purchasers of pocketed chain sheaves and guides, grooved idler sheaves and chain. All specification data required in ordering these products are given in the selector. David Round & Son.

ELECTRICAL

119 What You Should Know about Circuit Breakers — Sixteen-pp Manual 101 explains operating principles of basic circuit breaker designs and provides engineering data on factors of application. Includes simplified diagrams showing three basic types in general use. Illustrated with colored charts and diagrams, explains temperature factors, inrush current effects, tripping and reset time. Also discusses quick or slow make-and-break, and wire deterioration rates at various ampere values. Although dealing mainly with branch circuit protection, this manual should be of value to anyone concerned with circuit breaker application. Heinemann Electric Co.

120 FHP Motor Selector — This pocket-size slide rule provides detailed data on 35 motors in ratings from 1/2000 to ½ hp. Shows motor type horsepower continuous and intermittent, full load rpm, full load amps continuous and intermittent, load efficiency, ventilation, etc. on d-c and shade pole motors. Information on induction motors includes full load speed, horsepower, frame type and torque data. Howard Industries, Inc.

121 Cable Trough — Bulletin 65-A, 12 pp, uses drawings and photos to show how expanded metal cable trough can be used advantageously in supporting power and control cables. Photos of typical installations are also provided, as well as loading and deflection curves for various sizes of trough and a tracing template in three scales. T. J. Cope, Inc.

122 Radio, Electronic Equipment — This 1953 general catalog contains 236 pp and lists some 18,000 items, emphasizing equipment for industrial maintenance, research, etc. Covers electronic tubes, test instruments, voltage stabilisers, transformers, resistors, capacitors, relays, switches, fuses, tools, wire, cable and a variety of other equipment. Catalog is available to qualified power engineers; please state your title when requesting it. Allied Radio Corp.

123 Glass-Jar Batteries — This new 20-pp catalog on stationary batteries for auxiliary power and control offers excellent selection and installation information on glass-jar batteries in control, alarm, telephone, switchgear and signalling service. Provides specifications in scale-drawn and tabular form, on steel racks for batteries, giving recommended dimensions. Catalog discusses features, uses and installation procedures for Plote, Plante and other types of stationary batteries. Includes technical data, dimensions and weights. Gould-National Batteries, Inc.

124 Wiring Guide — Full information on company's line of surface metal raceways and fittings for electric light and power and telephone use, is provided in Catalog and Wiring Guide 19, a 120-pp, pocket-size handbook. Also contains illustrated data on company's latest development, 2000 Plugmold. The Wiremold Co.

FANS, VENTILATION

125 Industrial Fans — Eleven sizes of new industrial fans and their standard wheels are described in 12-pp Booklet SA-6873, which deals with fans ranging from 670 to 44,000 cfm at pressures to 16-in. mercury. Presents table of condensed specifications on performance and dimensions; discusses air-handling, material-handling, and long-shavings wheel types and gives applications for each. Arrangements in which fans may be obtained are shown, and accessories discussed. A table of maximum rpm's for fan sizes and operating temperatures is included. Sturtevant Div., Westinghouse Electric Corp.

126 For Efficient Air Distribution —Bulletin F 4471-1 describes grilles and registers and ceiling outlets, giving application information and discussing design advantages. Illustrated with photos, dimension drawings. Air Distribution Div., Barber-Colman Co.

TOOLS

127 Pipe Gage — This bulletin on company's pipe gage explains how it operates to measure any size pipe, electrical conduit and metallic tubing. Actual size photos show the gage, brief text covers its advantages. Three Point Industries.

128 Safety Marking Tools — Over 100 marking tools and devices are described and pictured in 28-pp Catalog 100. Includes photos, descriptive material, and size charts. Also gives information on a specially-developed alloy said to reduce spalling and increase marking life. M. E. Cunningham Co.

(*Continued on page 109*)

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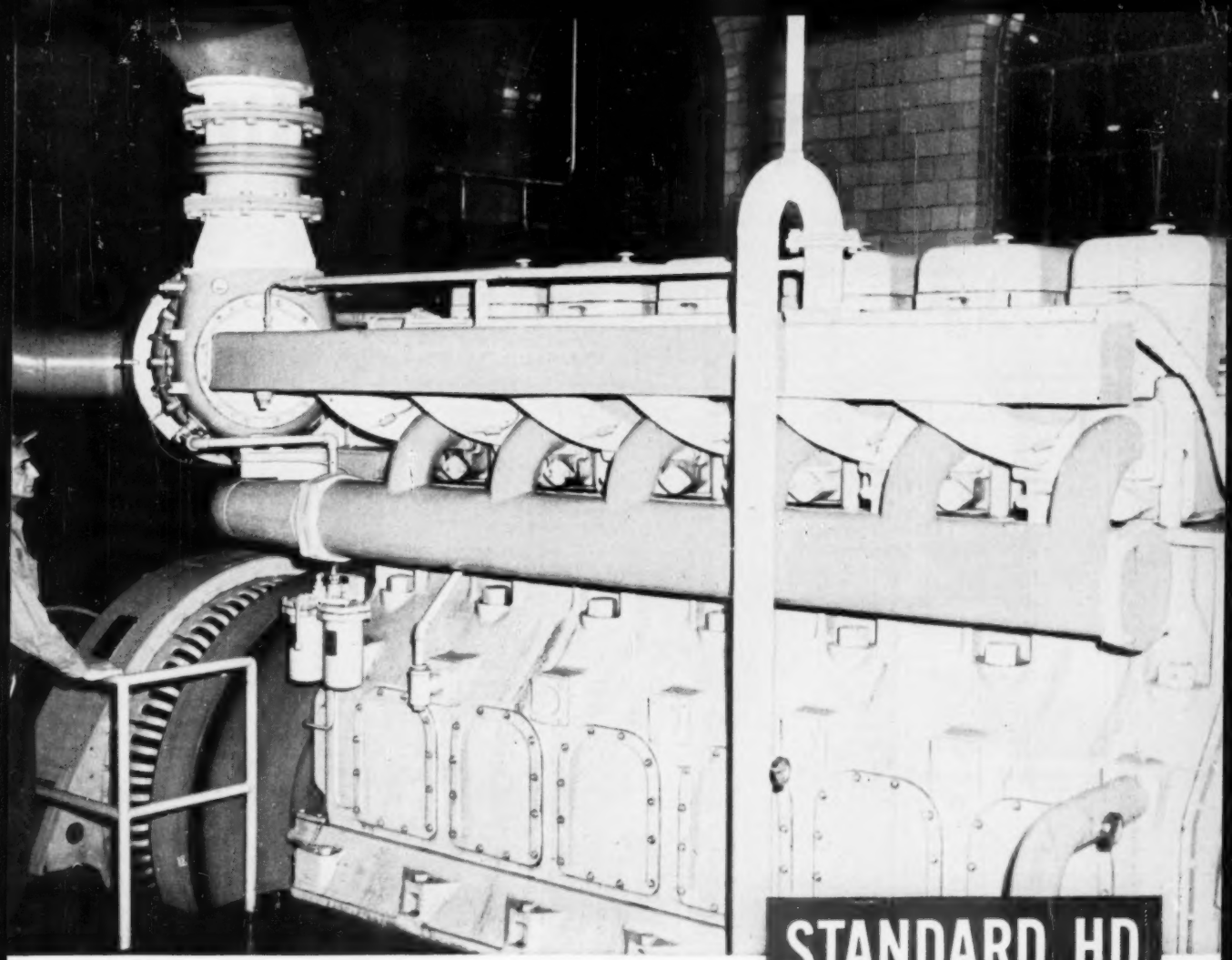


STANDARD HD
TRADE MARK
OIL

Gets maximum protection with...

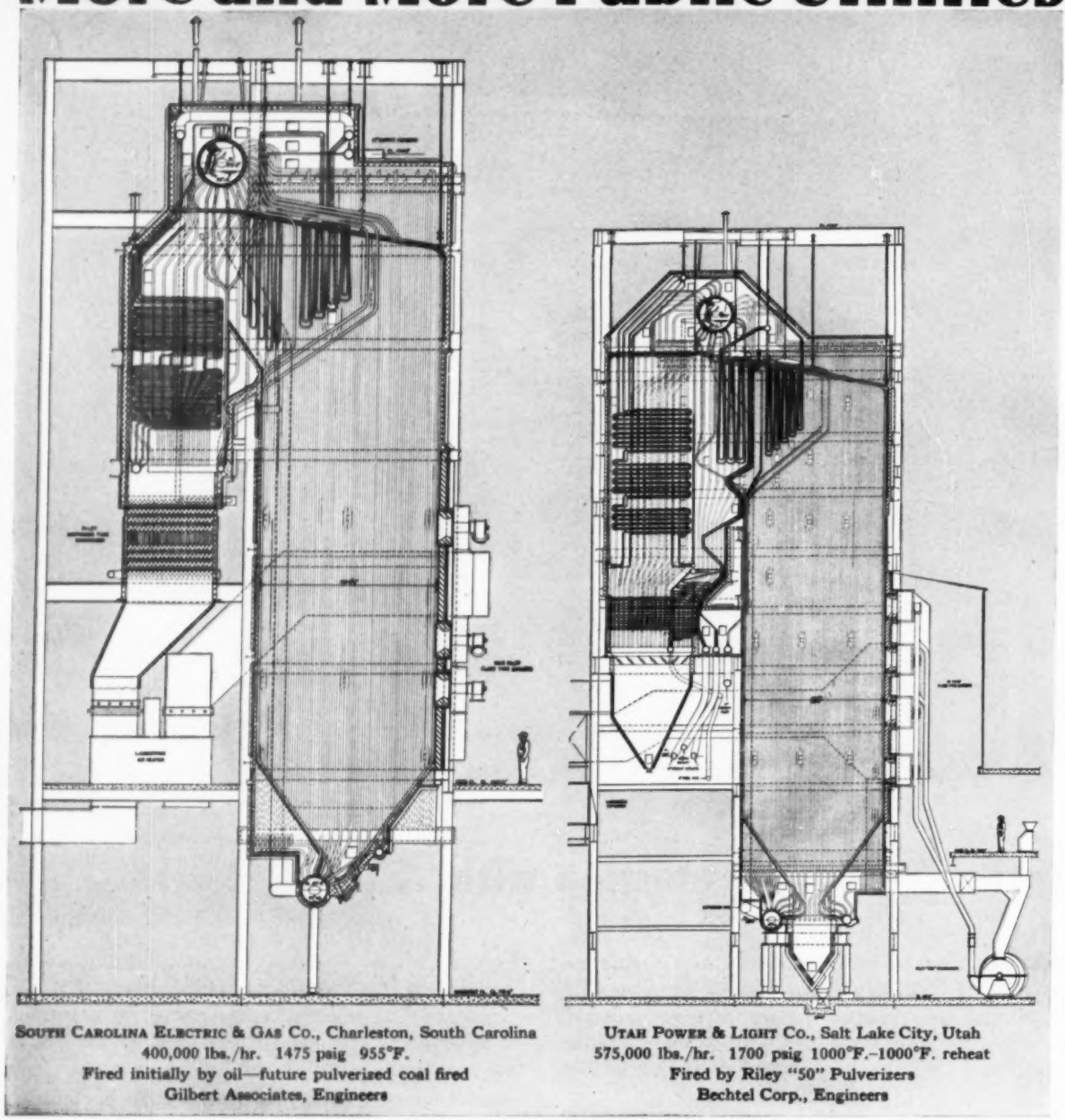
• At the time this supercharged diesel engine was installed in a municipal power plant, STANDARD HD Oil had already established an outstanding record for effective lubrication in the plant's other units. In the new unit, STANDARD HD has set a new high for efficient performance.

Most of the plant's load has been carried by the new, supercharged unit. In two years of continuous, hard service, STANDARD HD has supplied clean, protective lubrication. There have been no shut-downs for oil system maintenance. The original fill of oil has never been changed and has remained in excellent condition, as shown by periodic tests of oil samples.

The experience of this power plant, and that of a host of midwest diesel operators, indicates the savings you can make with STANDARD HD. The Standard Oil lubrication specialist serving your section of the Midwest will be glad to give you information about the use of STANDARD HD in plants near your own with which you may be familiar. You can contact the lubrication specialist by phoning your local Standard Oil office. Or write: Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (STANDARD) *(Indiana)*

More and More Public Utilities



South Carolina Electric & Gas Co., Charleston, South Carolina
400,000 lbs./hr. 1475 psig 955°F.
Fired initially by oil—future pulverized coal fired
Gilbert Associates, Engineers

Utah Power & Light Co., Salt Lake City, Utah
575,000 lbs./hr. 1700 psig 1000°F.–1000°F. reheat
Fired by Riley "50" Pulverizers
Bechtel Corp., Engineers

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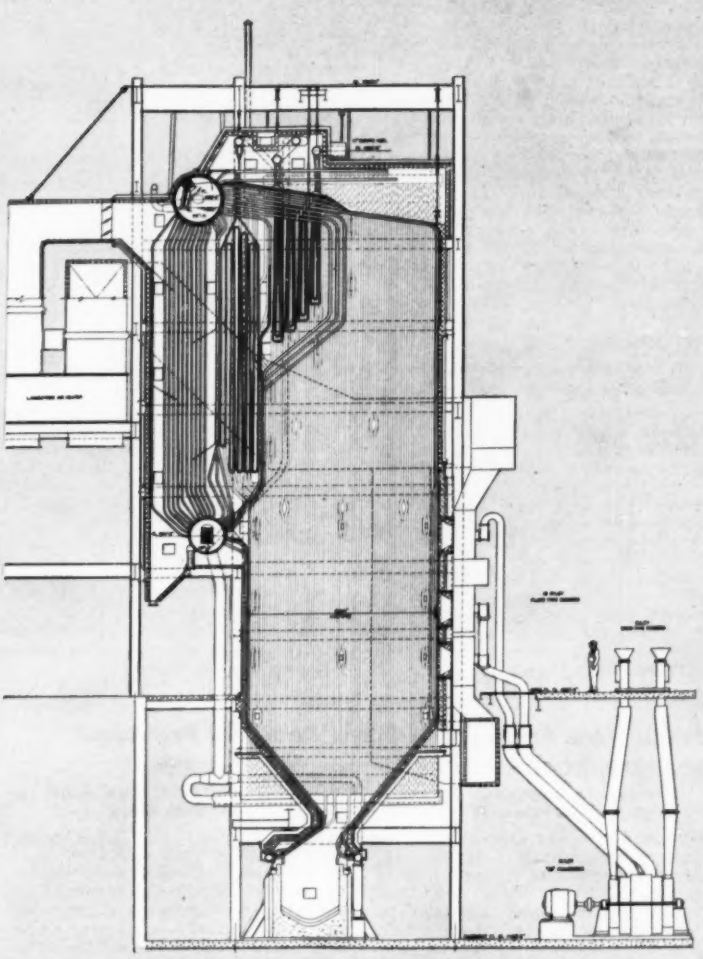


MONONGAHELA POWER CO.— THE POTOMAC EDISON CO., Albright, W. Va.
2–700,000 lbs./hr. 1050 psig 950°F.
Fired by Riley "50" Pulverizers
Sanderson & Porter, Engineers

A Few Recent Riley Units for Public Utility Plants

DEPARTMENT OF WATER AND POWER
CITY OF LOS ANGELES, CALIFORNIA
1,200,000 lbs./hr. 2075 psig, 1000°F. and 1000°F. reheat.

LOUISIANA POWER & LIGHT CO.
1,000,000 lbs./hr. 1725 psig, 1005°F. and 1005°F. reheat.

HOUSTON LIGHTING & POWER CO.
1,200,000 lbs./hr. 1700 psig, 1005°F.

SOUTHWESTERN GAS & ELECTRIC CO.
630,000 lbs./hr. 1050 psig, 1005°F.

MONONGAHELA POWER CO.
700,000 lbs./hr. 1050 psig, 905°F.

UTAH POWER & LIGHT CO.
575,000 lbs./hr. 1700 psig, 1000°F. and 1000°F. reheat.

CENTRAL ILLINOIS LIGHT CO.
600,000 lbs./hr. 950 psig, 900°F.

NORTHERN STATES POWER CO.
385,000 lbs./hr. 1500 psig, 950°F.

SOUTH CAROLINA PUBLIC SERVICE AUTHORITY
460,000 lbs./hr. 1025 psig, 900°F.

THE POTOMAC EDISON CO.
700,000 lbs./hr. 1050 psig, 905°F.

IOWA ELECTRIC LIGHT & POWER CO.
300,000 lbs./hr. 975 psig, 910°F.

GULF POWER CO.
325,000 lbs./hr. 1000 psig, 900°F.

SOUTH CAROLINA GAS & ELECTRIC CO.
400,000 lbs./hr. 1475 psig, 955°F.

UTAH POWER & LIGHT CO.
620,000 lbs./hr. 1500 psig, 955°F.

IOWA-ILLINOIS GAS & ELECTRIC CO.
250,000 lbs./hr. 975 psig, 905°F.

PUBLIC SERVICE CO. OF INDIANA
400,000 lbs./hr. 1000 psig, 910°F.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

For more data circle 527 on Post Card

Equipment News

SUMMARIZED HERE are new products and improved ones . . . recent developments of leading manufacturers who will gladly supply further information at no cost. You may use the no-obligation, postage-free cards on pages 48 and 109 for your request. Just list the numbers of the items you'd like to know more about

1—SCREW FEED

Serves as automatic conveyor for coal, bulk materials

The screw feed used in coal stokers is reported to have been successfully adapted as a large-scale automatic conveyor. Called Flo-Tubes, the cast iron trough is bolted together in sections capped with removable steel plates and inserted in the bottom of the bin or pile with end left exposed for pick-up. A Flo-Tube on an incline fills one hopper directly, or two hoppers by a Y-chute

arrangement as pictured. Horizontally, a single-Flo-Tube using gate valves can feed a battery of hoppers. High and low levels are maintained by off-on switches, automatically starting and stopping the screw feed.

The range of sizes offered convey up to 10,000 lb of coal, and manufacturer says shoveling can be almost completely eliminated if the bin bottom is slanted to feed the entry end of the Flo-Tube by gravity. Canton Stoker Corp.

2—CURRENT TRANSFORMER

Is 800-amp unit offered for indoor and outdoor use

An 800-amp unit has been added to manufacturer's JKP-O line of indoor-outdoor butyl-molded transformers. This line now covers ratings of 200:5, 400:5, 600:5 and 800:5. The ratings are obtained by passing the line conductor once through the window of the transformer; looping the primary conductor two or more times through the window provides additional ratings. The new 800-amp transformer has a 150 per cent continuous rating.

These transformers are applicable to both single-phase and three-phase circuits, and installations can be made outdoors on poles and walls and indoors in boxes and on walls. Meter and Instrument Dept., General Electric Co

3—PLUG-IN ALARM SYSTEM

Incorporates interchangeability of circuits and functions

The Panalarm 50 is described as unique in that a single, standard Panalarm can be used to signal any off-normal condition throughout a plant. Used either as running or trouble signals, these systems provide both an audible and a visual alert signal that must be acknowledged by the operator when an off-normal condition develops. Visual signals are by torpedo bullseye lamps or backlighted, illuminated nameplates.

The Panalarm 50 is a complete prewired multiple unit system designed to include all basic signal circuits. Changes of circuits, operating sequences or forms are made by connections on an enclosed terminal block mounted on the rear of the cabinet. Plug-in units are hermetically sealed. Standard systems are available providing for 3 to 54 individual signals operating with a common horn and acknowledgement push-button. Further information is given in Catalog 100. Panalarm Products, Inc.

4—NEOPRENE TAPE

Is self-affixing, for electrical wire and cable splicing

An easy-to-apply tape, Bi-Prene is said to provide a splicing medium with a high degree of oil and solvent resistance, when vulcanized, as well as outstanding dielectric strength and aging qualities. It conforms to irregular surfaces when wrapped under normal taping tension, and may be cured in a plant patching press to produce a smooth splice. Curing time is directly related to the depth of the splice section and the mold temperature — in most applications curing is done in minutes and at temperatures not over 310 F. Bi-Prene comes in 30-ft rolls. Bishop Mfg. Corp.

6—CYCLING CONTROL VALVE

Is offered for regulating cycles of flow in ion-exchange equipment

Primarily designed for controlling cycles of flow in ion-exchange equipment, the Cycloflow Valve is said to eliminate possibility of contaminating leakage by providing an isolated section connected to waste between the outlet and all sources of contamination.

The valve can be manually or automatically operated and requires a minimum of torque. Four double-acting pistons are used to provide positive valve action, actuated by a simple, integral fingertip control. The Cycloflow can be disassembled with a pocket wrench without removing piping connections. American Water Softener Co.

7—ILLUMINATOR

Is designed for quicker and easier reading of steam gages

This mercury vapor illuminator is intended to permit instant and accurate gage readings of boiler water level over longer distances, through dust particles in the air or deposits on the gage glass, or in poorly lighted areas. When a gage is equipped with this illuminator, the water column shows blue-green, topped with a bright emerald green spot at the water level.

The illuminator consists of a mercury vapor bulb enclosed in a steel housing, and a ballast box equipped for mounting at a convenient spot. The illuminator clips to the gage cover with brackets for easy installation without alterations to the gage. Weatherproof construction of the illuminator makes it suitable for outdoor use, company points out, and it's made in sizes to fit standard gage sizes. It's also available with a 100-w incandescent bulb for use on low pressure steam service gages. A descriptive catalog on the illuminator is offered. Jerguson Gage & Valve Co.

Some New Answers to Snow Removal Problems

5—SNOW SENSING DEVICE

Detects precipitation when temperature is below 37 F

Although designed primarily for deicing of microwave antennas, the Snow Detector has numerous applications wherever icing conditions and snowfall impair operation of moving parts and an electronically controlled heater will solve the problem. It is said to be especially useful for automatic operation of snow removal systems for sidewalks etc.

Only 7¼ in. dia, the unit is designed to detect snow when the ambient temperature drops below 37 F. An integral heater melts snow and ice collected in the "bowl", but no power is consumed by either the detector or by heaters at higher temperatures. Wall, roof and pole mountings are possible — vertical rods around the edge of the unit keep the birds from nesting in it.

The detector operates automatically, turning on heating elements when icing conditions exist. Up to 30 amp at 117 v a-c can be switched without external relays, company says, and the heaters stay on until the icing hazard is past, being automatically turned off. Motorola, Inc.

8—SNOW PLOW

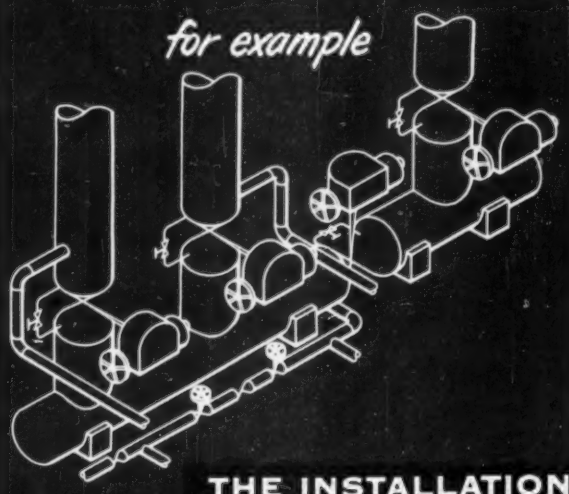
Teams up with fork truck to clear the snow away

Manufacturer of this attachment says it can be used on all of company's pneumatic-tired fork trucks except the 1000-lb Trucloader. The plow is a non-hydraulic attachment adjusted manually to several blade angles and mechanically adaptable to uneven ground surfaces. The ballast

box, mounted over truck forks, may be loaded with any kind of material to provide traction. Industrial Truck Div., Clark Equipment Co.

Are Your Valves Giving this Low-cost Service?

...on Main Steam Lines, for example



THE INSTALLATION

Crane 900-Pound Pressure-Seal Bonnet Gate Valves, motor-operated, on main steam header, in a mid-western public utility power station.

VALVE SERVICE RATINGS

FEATURES:	Pressure-Seal Bonnet Joint and Flexible Wedge Disc
SUITABILITY:	Latest High Pressure Service Design
MAINTENANCE COST:	None in 4 years - except lubrication
SERVICE LIFE:	Should outlast any bolted bonnet valve
OPERATING RESULTS:	No forced outages for valve repairs
PRICE:	In line for modern, high quality valves
AVAILABILITY:	Regular item in Crane line

THE HISTORY

This battery of 10-inch Crane Pressure-Seal Bonnet Gates has been in operation about 4 years on 825° F. —825 psi steam. Their performance is rated in direct comparison with bolted-bonnet valves, same size and pressure class, on identical service in the station.

While installed some years earlier, the bolted-bonnet valve records show considerable repairs for seat leakage, and difficulty in keeping bonnet joints tight. The plant also reports trouble with discs sticking shut.

In contrast, Crane Pressure-Seal Valves have given satisfaction since installed. Seats and bonnet joints alike remain leak free, tight as new. Valve operation is smooth and positive.

THE VALVE

Here is simplified development of the pressure-seal bonnet principle. Crane Pressure-Seal Gate Valves eliminate bonnet joint leakage and maintenance with a one-piece seal ring design, using no gaskets or auxiliary parts. Readily accessible, the joint needs no special tools for dismantling. Self-adjusting to temperature effects, Crane flexible wedge disc prevents sticking; takes minimum torque to open, hot or cold. See your Crane Representative or your Crane Catalog for full data on these modern valves in 600, 900 and 1500-pound pressure classes.

The Complete Crane Line Meets All Valve Needs. That's Why

More Crane Valves Are Used Than Any Other Make!

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

For more data circle 528 on Post Card

9—V PACKING RINGS

Moulded from Teflon, are being produced in two designs

Both low pressure and high pressure (up to 5000 psi) types are available in these Teflon packing rings. Company says both types can be used against any substance (only molten sodium and fluorine at high pressure change Teflon chemically) within the temperature range of −90 to 500 F. Both types are said to give a long-lasting effective seal at low gland pressure and a minimum of friction, and good results are reported on both reciprocating and rotating applications involving valves, pumps and fittings. Packing Div., Flexrock Co.

10—COMPRESSOR

Offers new design features and operational advantages

The Spiraxial Compressor is announced as entirely new in principle and design within its range. Instead of conventional rotors, this air or gas compressor employs two intermeshing screw-rotors which rotate in opposite directions. These screws are operated by gears synchronized to prevent contact, allowing close but definite clearances.

The flow of air or gas is axial with most of the compression taking place at the back of the casing, company explains, and this permits a large inlet opening to prevent strangulation of inlet air and to increase volumetric efficiency. Five advantages are claimed for this new compressor design: peak efficiencies at discharge pressure determined by requirements; no internal lubrication; minimum of servicing; low noise level, and light weight. Bulletin CS-152 gives full construction details on the compressor. Roots-Connersville Blower.

11—SCREW EXTRACTORS

For quick and easy removal of screws, other threaded forms

Announced as ideal for the removal of broken screws, bolts, studs or other threaded forms without injury to the tapped threads, these screw extractors come in nine sizes. They're individually packaged in cardboard envelopes and in sets complete with maple block stand. J. H. Williams & Co.

Want more details on these new products? Just circle the item numbers on post cards on pages 48 and 109

13—LIGHT-WALL TUBING

Seamless, is now being produced in larger sizes

An increase in the size range of this company's seamless light-wall tubing from 1¼ in. OD maximum to 2 1/16 in. OD maximum is announced. This is expected to increase the number of applications of light-wall tubing, particularly where pressures exceed the limits for welded tubing. Present uses for large diameter seamless tubing include instrument bellows, flexible metal hose, and low pressure heat exchanger tubes.

The new tubing is furnished in stainless steel (ASI Types 304, 321 and 347) and in Monel. Length range is from 5 to 22 ft in random, multiple or cut lengths. Bulletin 32 gives detailed information. Superior Tube Co.

14—TRANSFORMERS

For control circuit applications, are ruggedly constructed

Three more sizes — 30 va, 50 va and 150 va — have been added to this company's line of control circuit transformers previously ¼ kva through 10 kva. The new models are of the same conservative electrical design and rugged construction as the larger models, manufacturer says, and an important feature is better voltage regulation in low power factor circuits when the momentary overload caused by high inrush current is encountered.

Firmly anchored screw type terminals are used eliminating need for terminal boards, and the coil leads are soldered to the terminals and taped to the coil in the winding operation. Bulletin T-5111 on these transformers is available. Hevi Duty Electric Co.

15—FUSE COMPARTMENT

For easier fuse replacement for high voltage motor control

A new gang-operated disconnect method for de-energizing fuses on high voltage motor control is designed to make them safe and convenient for handling. The Sa-Fuse Compartment uses a movable panel on which current-limiting fuses are gang-mounted. The fuse panel has disconnecting blades behind the panel. When the compartment door is opened, the fuse panel is automatically pulled to the front, disconnecting it from the line

and putting the fuses within easy reach, it is explained, and the operator can then safely remove and replace fuses without a hook stick.

Mechanical and electrical interlocks are used to prevent fuses being disconnected when the switch is closed and to prevent closing motor switch with door open. Target indicators on door tell whether motor switch is opened or closed, and whether fuse panel is connected or disconnected. Publication 3300-PRD-211 describes advantages and operation of the Sa-Fuse Compartment. Electric Machinery Mfg. Co.

16—DUAL-STAGE BURNER

Is designed to combine steam and mechanical atomization

Tested in the power, petroleum and chemical industries, this burner is reported to have the inherent advantages of both steam and mechanical systems of atomization. Oil entering the burner is first mechanically atomized in an internal swirl chamber. After leaving the mechanical stage, the partially atomized fuel is sprayed into a mixing chamber where it is further atomized by steam. Capacities from 80 to 300 gph have been obtained, manufacturer says. A detailed description of the burner is provided in Bulletin 25. National Airoil Burner Co.

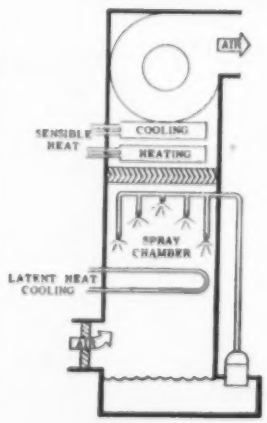
17—PRESSURE TRANSDUCER

Is miniature instrument for pressure measurement applications

Pressure measurements, including surveys of hydraulic-system and pipeline pulsations, are said to be simplified with the new Type 4-310 Star Pickup, announced as one of the smallest instruments of its type designed for quantity production. It measures only ½ in. dia, is less than ¾ in. long and weighs only 20 oz. Its flush diaphragm is intended for insertion directly into a process vessel or stream of liquid or gas for test purposes. The unit may be used with

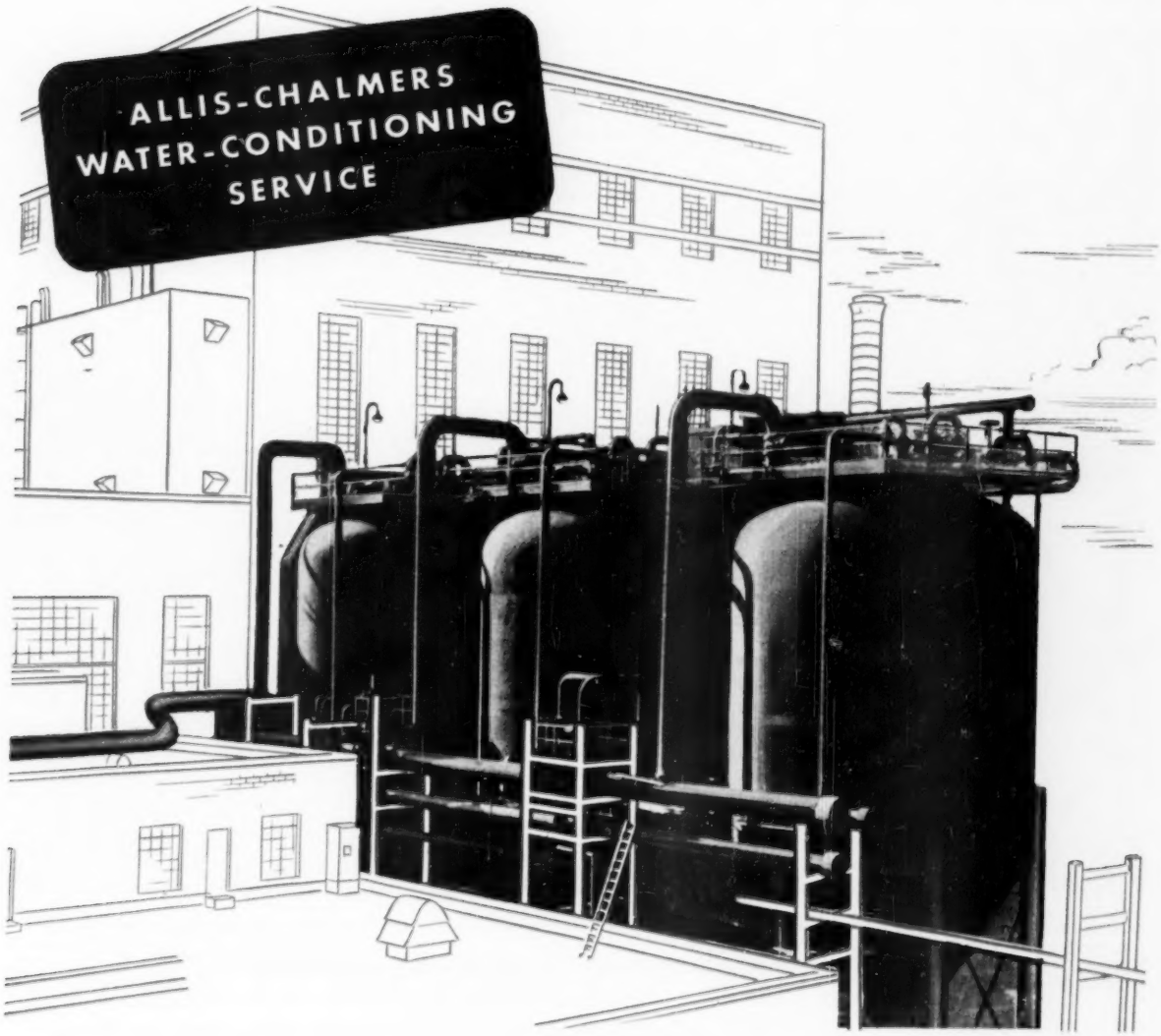
12—IMPROVED AIR CONDITIONING APPARATUS

Is designed for the drying or moistening of atmospheric air



In the new "liquid contact method" announced by this manufacturer, air is treated to fix relative humidity and temperature independently, as separate functions, to obtain closer control of results. Filtered fresh air enters a new type of spray chamber providing intimate contact between air and spray liquid. The spray either adds moisture or removes it by absorption or by condensation.

Spray liquid used for removing moisture may be either refrigerated water or company's Hygrol, a stable organic absorbent liquid automatically held at the proper concentration. Applications for the new apparatus include establishment of dry atmospheres for processing and drying jobs, and comfort air conditioning. In the latter, this method makes possible large amounts of fresh dry air with moisture removed at low cost, letting the cooling or heating be done economically with room conditioners. Niagara Blower Co.



WATER HARDNESS CUT TO ZERO

at record rate of 240,000 gallons per hour!

THIS king-size, outdoor water-softening system was recently installed by Allis-Chalmers to meet the special needs of a leading midwest oil refinery. It furnishes four high-pressure boilers with filtered treated water at the extraordinary rate of 240,000 gallons per hour — the largest water-softening system ever installed in a refinery power plant.

Extremely rugged and designed for year-round operation outdoors, this Allis-Chalmers system has been in service about four years. There have been no breakdowns, and maintenance costs have been practically nil.

Whatever *your* industry—paper, petroleum, food, steel—you'll get prompt, convincing results with Allis-Chalmers Water Conditioning service.

For over 50 years Allis-Chalmers has been building power generation equipment. This experience is invaluable in providing our water conditioning specialists with the extensive background needed today to recommend correct equipment, chemicals and service.

An expert representative is available, ready to recommend proper chemicals or help select the right process for your power plant requirements. For complete information, contact your nearby Allis-Chalmers District Office, or write Allis-Chalmers, Milwaukee 1, Wis.

A-3916

ALLIS-CHALMERS

GENERAL MACHINERY DIVISION

MILWAUKEE, WIS. — PITTSBURGH, PA. — NORWOOD, OHIO — BOSTON, MASS. — TERRE HAUTE, IND. — MONTREAL, P. Q. — ST. THOMAS, ONT.

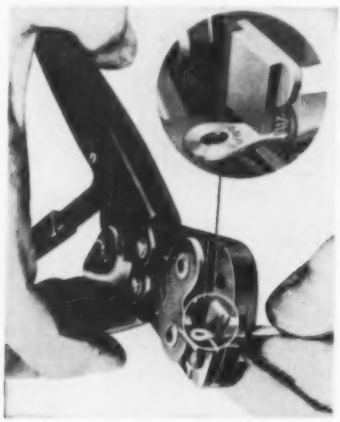
For more data circle 529 on Post Card

recorders for permanent test records, or with visual indicators and meters for on-the-spot measurements. High accuracy credited to the instrument is said to make it applicable to studies of high-speed pumps and compressors. Bulletin CEC 1534 gives detailed specifications. Consolidated Engineering Corp.

18—HAND TOOL

Is designed to crimp solderless terminals to thinly insulated wires

Wires having extremely thin insulation sheathing are difficult to terminate because, unless great care is taken, both wire and insulation may be forced into the terminal barrel. To solve this problem, a wire positioner called the



Shur-Stop is incorporated in the Amp Certi-Crimp Hand Tool. This positioner acts to stop the stripped wire in its proper place. In addition to this feature, two other positioners help to produce perfect terminations: a terminal guide orients the terminal correctly in the tool jaws and a barrel-stop positions the terminal at the proper crimping area. Aircraft-Marine Products, Inc.

19—LITTLE OILER

Is fountain-pen size and can be clipped to a pocket

Maintenance men and electricians can have oil at their fingertips with the Handee Oiler. This little tool has a Tenite plastic case, resembles a ball-point fountain pen and is easily filled. It is designed to deliver a controlled amount of oil — from a drop to a squirt. After using it, you lock the knurled knob at the head, wipe off the oil and put it back in your pocket. Company says it's guaranteed not to leak, and it retails for less than a dollar. Clover House.

20—CABLE CLAMPS

Of non-inflammable plastic, offer many advantages

These cable clamps are made of Saran, a strong thermoplastic material offering good electrical and thermal properties as well as inertness to fungicidal attack, ability to withstand changes in atmospheric conditions and resistance to corrosion or sweating. Saran is also said to be unaffected by prolonged immersion in water, to be non-toxic and to have good abrasion resistance.

Because Saran is pliable, these clamps can be opened for easy sliding over wires, cable, pipe or tubing. And being resilient, the plastic clamps eliminate the need for lock washers in some instances. The clamps come in 17 sizes from ⅛ to 1¼ in. Holub Industries, Inc.

21—DEMINERALIZER

Is compact unit for providing water of high purity

The M–100 Mono-Column Demineralizer with a capacity of 4500 grains is designed for users of up to 100 gph of super high purity water. The unit requires only connection of influent to a plant's water system and connection of effluent to points where purified water is required. Raw water enters the unit at the influent and after passing once through the mono-column of mixed cation and anion resins is received at the effluent stripped of impurities, company explains.

A flow meter on the influent affords control of water intake for the most efficient ion exchange action, and an electric purity meter gives continuous indication of the purity of the demineralized water received. Operating costs are reported to average 15 to 30 cents per 1000 gal for mineral free water. Complete catalog information on this is available. Penfield Mfg. Co., Inc.

22—INDICATOR-CONTROLLER

Is self-balancing unit with easily-read scale, plug-in chassis

The Type RI-C Indicator-Controller, primarily designed to meet the needs of industrial control and measurement of solution concentrations, incorporates several new features. It is entirely self-balancing and requires no adjustments or resetting, it is announced. The direct-reading scale indicates solution concentration in micromhos or other specified units. Provision is made for up to four separate electrical switches for alarm and control. In addition, air control 3 to 15 psi for remote operation, or a combination of both electrical and air control is available. The unit is housed in an aluminum case for wall or panel mounting and may be purged of corrosive fumes through internal air pressure. Industrial Instruments, Inc.

24—TRANSMITTER

Differential pressure primary element, for control systems

The Type D2T Autronic Differential Pressure Transmitter is used in conjunction with company's Autronic Control System and covers a differential pressure range of 0 to 20 in. to 0 to 200 in. water at static pressures to 1500 psig. Installed at the point of measurement, the unit transmits an electric signal which is directly proportional to the variable being measured. Manufacturer points out that since the control system is all-electronic, response is instantaneous. The pressure transmitter is extremely compact. The Swartwout Co.

25—SUMP PUMP

Features bronze construction and stainless steel shaft

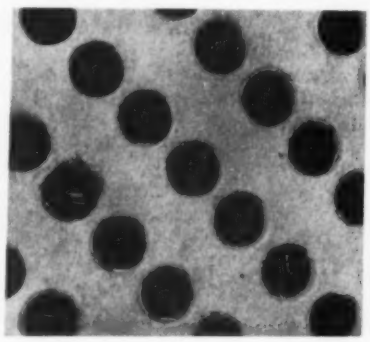
This improved sump pump with discharge capacity as high as 3050 gph is suggested for draining pits, boiler rooms, elevator shafts and similar areas. The vertical centrifugal pump has a hydraulically balanced impeller, ball-shaped base and a strainer to protect the pump from clogging. This strainer can be cleaned without removing pump from the sump. The standard NEMA ⅓ hp continuous duty induction type motor has built-in overload protection and rubber-covered 8-ft cord and plug. The switch is operated by two plastic weights connected by a strong flexible Monel cable. Weights can be adjusted to operating level. The F. E. Myers & Bro. Co.

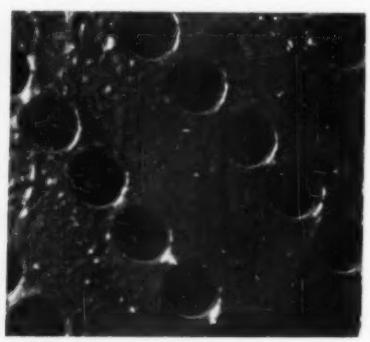
23—CONDENSER TUBE AND SHEET PROTECTION

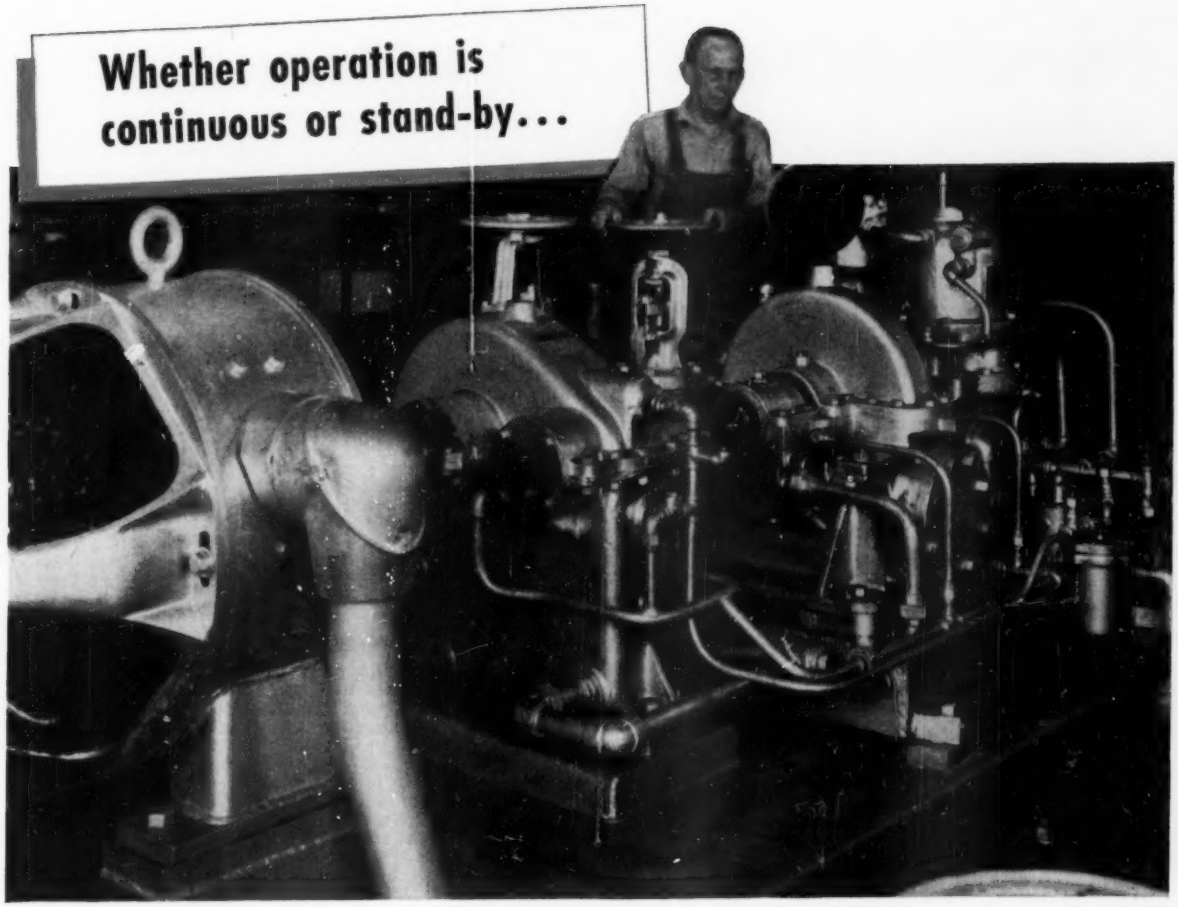
Is a Neoprene-base coating which is applied to surfaces by spraying

How this sprayed-on coating works to protect condenser tube and sheet is shown in these photos of an actual application. Pictured at left are condenser tubes normally having a wall thickness of 0.077 in., but eroded to less than 0.010 in. The sprayed-on application re-established the eroded ends, as shown at right and extended back into the tube approximately 6 in. According to company, a coating of 0.064 in. was applied to the interior of the tube and 1/16 in. on the tube sheet with the coating carried to the water box for sealing. This process not only preserved the tubes and tube sheet, it is reported, but also eliminated leakage and condensate contamination.

There were 17,800 ⅞-in. dia tubes in the 113,000 sq ft condenser. Two priming coats and eight coats of the Neoprene-base rubber were applied in 43 hr by a four-man crew. To have re-tubed the condenser would have required an extra 6 weeks outage, it is claimed — and the rubber application is said to have cost less than 5 per cent of a re-tubing job. Manufacturer of this coating says it develops an adhesion of 800 psi, is tough and lasting, is air curing and may be placed in service within 36 hr after application. Synco Corp.







TYPE E turbines can handle it!

In the powerhouse of William F. Schrafft & Sons, makers of the famous "Schrafft's Chocolates," Charlestown, Massachusetts, the Type E turbine is used on a 40-kw, d-c exciter. The turbine exciter is supplementary to a motor-driven exciter for one 750- and two 1000-kw Westinghouse Turbine-Generators.

Of this installation, both the Chief Engineer and the Chief Power Plant Operating Engineer stated, "We are impressed by the design, appearance, and smooth-running qualities of the Type E turbine, and also the unique design of the oil-relay governor and forced-feed lubrication which the Type E provides." This all-Westinghouse end of Schrafft's power plant includes a new 1000-kw Westinghouse Geared Turbine-Generator, served by existing Westinghouse switchboard equipment and motor-generator sets.

Here's the general-purpose turbine that meets the many stern demands of modern industry. Regardless of operating conditions, the Type E is built to give dependable, trouble-free, economical performance for long periods of continuous operation . . . or instant operation when used as a stand-by drive.

Other types in the complete Westinghouse general-purpose turbine line include heavy-duty and multi-stage units for applications requiring higher temperatures and pressures, higher speeds, greater horsepower, extraction for process applications or higher efficiency than can be obtained with single-stage machines. Get the facts on this broad turbine line . . . call your nearby Westinghouse Office, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-50540

YOU CAN BE SURE...IF IT'S
Westinghouse

TYPE E Turbines

For more data circle 530 on Post Card

POWER PLANT *Construction News*

Abbeville, Ala. — Pepperell Mfg. Co., Pepperell, Ala., wide sheetings and other cotton goods, is reported planning boiler plant at new mill unit at Abbeville. It will be one-story, reported to cost about $600,000, with equipment. Work scheduled to begin soon. Robert & Co. Associates, Inc., 96 Poplar St., N.W., Atlanta, Ga., is architect and engineer.

Florence, Ala. — Stylon Corp., Milford, Mass., ceramic wall tile, etc., has concluded arrangements with town officials at Florence for construction of new plant on local site, including boiler house, to be occupied under long-term lease. Erection is scheduled to begin soon. Entire project is reported to cost $1,300,000, and bond issue has been sold in that amount by municipality.

Ketchikan, Alaska — Ketchikan Pulp Co. plans power house at new pulp mill at Ward Cove, near Ketchikan. It will comprise a number of one and multi-story buildings, equipped for a rated capacity of over 100,000 tons of pulp per annum. Entire project will cost about $36,000,000, and financing in that amount has been arranged. Work is scheduled to be placed under way immediately, with mill to be ready for service in 1954. Company is a recently organized subsidiary of American Viscose Corp., 1617 Pennsylvania Blvd., Philadelphia, Pa., and Puget Sound Pulp & Timber Co., Bellingham, Wash., jointly owned.

Los Angeles, Calif. — Anheuser-Busch, Inc., 721 Pestalozzi St., St. Louis, Mo., beer and ale, plans steam power house at proposed new brewing plant in San Fernando district, Los Angeles, where tract of 65 acres of land has been acquired. It will comprise a number of one and multi-story buildings, with entire project to represent an ultimate investment of about $45,000,000. Holmes & Narver, 828 South Figueroa St., Los Angeles, are architects.

Los Angeles, Calif. — Heller Co., 2135 Superior Ave., N.E., Cleveland, Ohio, wire stitching machines and kindred equipment, plans boiler house at proposed new branch plant at Los Angeles, where site has been acquired. It will be one-story, totaling about 100,000 sq. ft. floor space. Entire project reported to cost in excess of $500,000.

Van Nuys, Calif. — Joseph Schlitz Brewing Co., 235 West Galenia St., Milwaukee, Wis., beer and ale, plans large boiler plant at new brewery, near Van Nuys, where tract of close to 35 acres of land has been secured for site. It will consist of a series of one and multi-story structures, equipped for an initial output of 1,000,000 bbls. per year. Cost reported about $20,000,000. Harley, Ellington & Day, 153 East Elizabeth St., Detroit, Mich., are architects and engineers.

Fort Pierce, Fla. — Municipal Electric Dept., Avenue A, has approved plans for expansion in municipal steam-electric generating station, with installation of additional equipment. No official estimate of cost announced. Work will proceed at once.

Savannah, Ga. — Savannah Electric & Power Co., 27 West Bay St., has plans maturing for an addition to Riverside steam-electric power plant, with installation of new turbine-generator, high-pressure boiler, and auxiliary equipment. Contract for structural steel framing for superstructure has been let. No official estimate of cost announced. Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass., is consulting engineer.

Barrington, Ill. — Barco Mfg. Co., 1801 West Winnemac St., Chicago, Ill., flexible joints, recorders, indicators, etc., is reported planning boiler house at proposed new plant at Barrington. It will be one-story, about 100,000 sq. ft. floor space, and is estimated to cost close to $800,000. Construction will begin at early date.

Danville, Ill. — Illinois Power Co., 134 East Main St., Decatur, Ill., has plans under way for new steam-electric power plant near Danville, reported to cost in excess of $3,000,000, with equipment. Sargent & Lundy, 140 South Dearborn St., Chicago, Ill., are consulting engineers.

Indianapolis, Ind. — Cold Metal Products Co., Youngstown, Ohio, cold rolled steel strip, plans steam power house at proposed new mill at Indianapolis. It will be one-story, about 210 x 500 ft. Proposed to begin work in 1954. Entire project will represent a reported investment of about $3,500,000.

Great Bend, Kan. — Western Light & Telephone Co., Huron Bldg., Kansas City, Kan., has selected a tract of about 80 acres of land, approximately 5 mi. from Great Bend, as site for proposed new steam-electric generating plant, recently referred to in these columns. It will be equipped for an initial capacity of 15,000-kw., and is reported to cost over $3,000,000, with turbine-generator, high-pressure boiler and accessory equipment. Proposed to begin work soon. Sargent & Lundy, 140 South Dearborn St., Chicago, Ill., are consulting engineers.

Protection, Kan. — Municipal Electric Dept. will carry out expansion in municipal Diesel-electric power plant, with installation of new generating unit, about 400-kw. capacity and auxiliary equipment. Work scheduled to be carried out at once. No official estimate of cost announced. Rocky Mountain Engineering Co., Wilda Bldg., Denver, Colo., is consulting engineer.

Ford, Ky. — Eastern Kentucky Electric Cooperative, Inc., will proceed with superstructure for proposed new steam-electric generating plant at Ford. Installation will include turbine-generators, high-pressure boilers, and auxiliary equipment. Work is scheduled for completion late in 1954. Entire project will represent an investment of about $15,000,000. Financing has been arranged through Federal aid. Burns & McDonnell Engineering Co., 95th and Troost Sts., Kansas City, Mo., is consulting engineer.

Crystal Falls, Mich. — Municipal Light & Water Dept., City Hall, is considering expansion in municipal hydroelectric power plant, with installation of new turbine-generator unit and auxiliary equipment. Estimates of cost will be made by Holland, Ackerman & Holland, 20 North Wacker Dr., Chicago, Ill., consulting engineers.

Akron, N. Y. — Carborundum Co., Niagara Falls, N. Y., grinding wheels and abrasive materials, plans boiler plant at new factory near Akron, where tract of 18 acres of land has been acquired. It will be used for production of zirconium and allied metals. It will comprise several buildings, equipped for large output, and is reported to cost in excess of $2,500,000. Work will begin soon.

Mineola, L. I., N. Y. — Long Island Lighting Co., Mineola, is planning an expenditure of about $80,000,000 in 1953-54, 24 mo. period, for expansion and improvements in plants and system, including increased generating capacity, power substations, transmission and distributing lines, and other operating facilities. This is in addition to $45,000,000, which company has budgeted for similar work in 1952. Work is now nearing completion on new generating plant of 100,000-kw. rating, scheduled to be placed in service this fall.

Potsdam, N. Y. — Niagara Mohawk Power Corp., 250 Park Ave., New York, N. Y., has plans maturing for new hydroelectric generating plant on Raquette River, near Potsdam, reported to cost about $4,000,000, with hydraulic turbines, electric generators, and auxiliary equipment.

Wilmington, N. C. — Carolina Power & Light Co., Raleigh, N. C., will expend about $17,000,000 for proposed new steam-electric generating station on Cape Fear River, near Wilmington, previously referred to in these columns. Plans are maturing and work is expected to begin in near future. New station will be equipped for an initial capacity of 110,000-kw.

Chouteau, Okla. — Deere & Co., Moline, Ill., agricultural and farm machinery, has engaged W. R. Holway & Associates, 302 East 18th St., Tulsa, Okla., consulting engineers, to prepare plans for proposed new plant and power house at Chouteau for manufacture of ammonia and ammonia solutions, recently referred to in these columns. Project will comprise a number of one and multi-story buildings, and is reported to cost approximately $20,000,000. It is understood that work will begin in 1953.

Springdale, Pa. — West Penn Power Co., West Penn Bldg., Pittsburgh, Pa., has secured permission from Defense Production Administration, Washington, D. C., to proceed with proposed expansion in steam-electric generating plant at Springdale, previously noted in these columns, with expenditure approximating $19,000,000. Installation will include a new 135,000-kw. turbine-generator unit, high-pressure boilers, and auxiliary equipment. Sanderson & Porter, 52 William St., New York, N. Y., are consulting engineers.

Simpsonville, S. C. — Trinacria Specialty Mfg. Co., Norwich, Conn., textile mill equipment, loom crankshafts, etc., plans boiler house at proposed new plant at Simpsonville, where site has been secured. Cost reported in excess of $100,000. Work scheduled to begin soon.

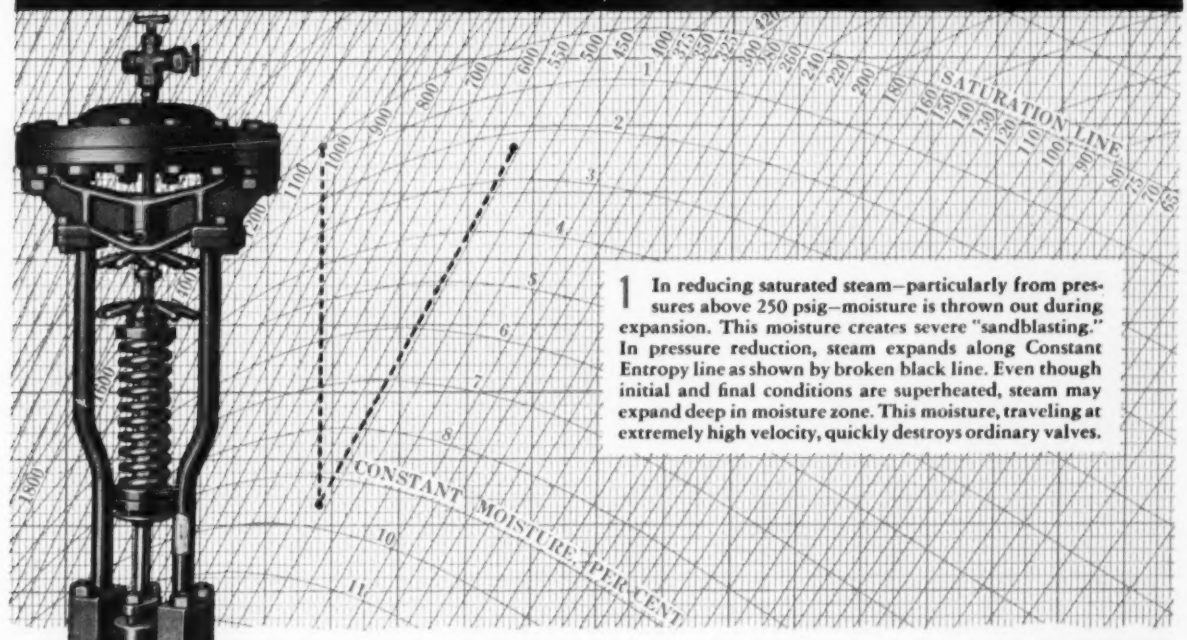
Hondo, Tex. — Medina Electric Co-operative, Inc., Hondo, plans new steam-electric power plant in vicinity of city, to be equipped for an initial rating of 13,500-kw. Cost reported about $3,000,000, with power substations, transmission lines, and other operating facilities. Financing has been arranged through Federal aid.

Houston, Tex. — Sheffield Steel Corp., Industrial Rd., steel specialties, has approved plans for new boiler house at local plant. Work will be carried out in connection with a new locker building, entire project to cost about $225,000. Work scheduled to begin at once. H. K. Ferguson Co., 2620 Main St., Houston, is engineer. Main offices of company are on Shepherd Ave., Kansas City, Mo.

Tyler, Tex. — Board of Texas State Hospitals and Special Schools, 45th and Lamar Sts., Austin, Tex., plans boiler house for central-heating service at proposed new State Tubercular Hospital at Tyler. Cost estimated about $2,000,000. Walter C. Moore, address, noted is architect for Board.

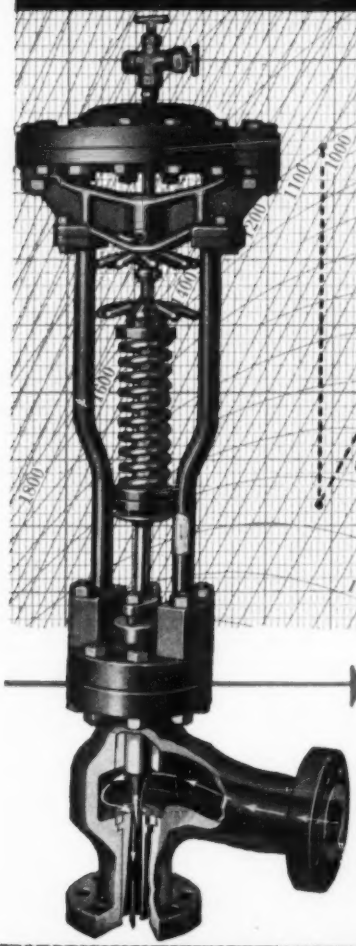
Everett, Wash. — Scott Paper Co., Chester, Pa., tissue papers, plans large boiler plant at proposed new branch mill at Everett. It will comprise several one and multi-story buildings, and is reported to cost approximately $21,000,000. Work is scheduled to begin early in 1953.

Swartwout V-10 Flow Regulating Valves slash maintenance costs in systems with high pressure drop or flashing condensate



1 In reducing saturated steam—particularly from pressures above 250 psig—moisture is thrown out during expansion. This moisture creates severe "sandblasting." In pressure reduction, steam expands along Constant Entropy line as shown by broken black line. Even though initial and final conditions are superheated, steam may expand deep in moisture zone. This moisture, traveling at extremely high velocity, quickly destroys ordinary valves.

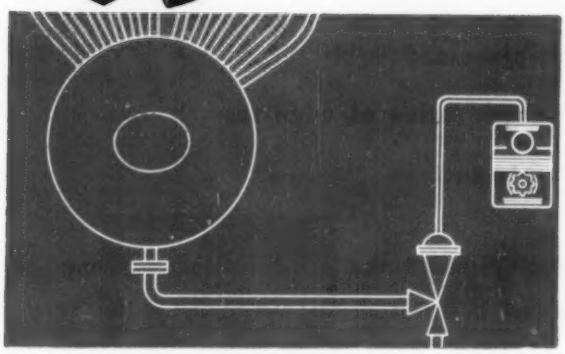
Chart from *Thermodynamic Properties of Steam* by Keenan & Keyes. Reproduced by permission of John Wiley & Sons, Inc., Publishers



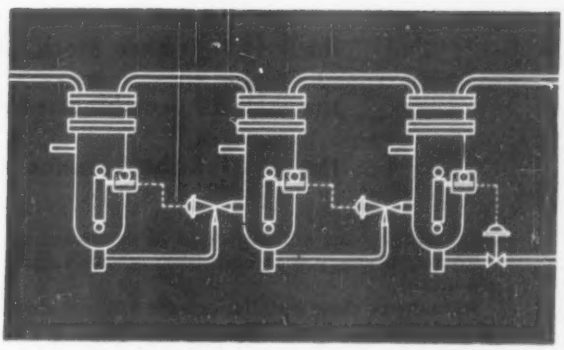
2 Swartwout V-10 valves are scientifically designed to handle liquids at high pressure drops and also under *flashing conditions.* All direct impingement is eliminated and longer valve life is assured two ways—by better flow design, plus use of materials specifically selected for the service involved. As a result, *Swartwout V-10 valves outperform other valves in similar service.*

Swartwout

POWER PLANT EQUIPMENT
PROCESS INDUSTRY CONTROLS
INDUSTRIAL VENTILATION



3 High pressure boiler blowdown service is extremely rigorous. When closed, there is full pressure drop across valve; when open, high velocities and flashing rapidly increase line loss and decrease the allowable drop across the valve. The variations in pressure make this service critical since valve must handle all conditions.



4 In saturated liquid drainage service, such as on high pressure extraction type heaters, water at saturation temperature flashes into steam when pressure is reduced. Exclusive scroll inlet and gradually expanded straight outlet of V-10 valve design permit a sliding action instead of direct impingement thus preventing corrosion-erosion. A-4206

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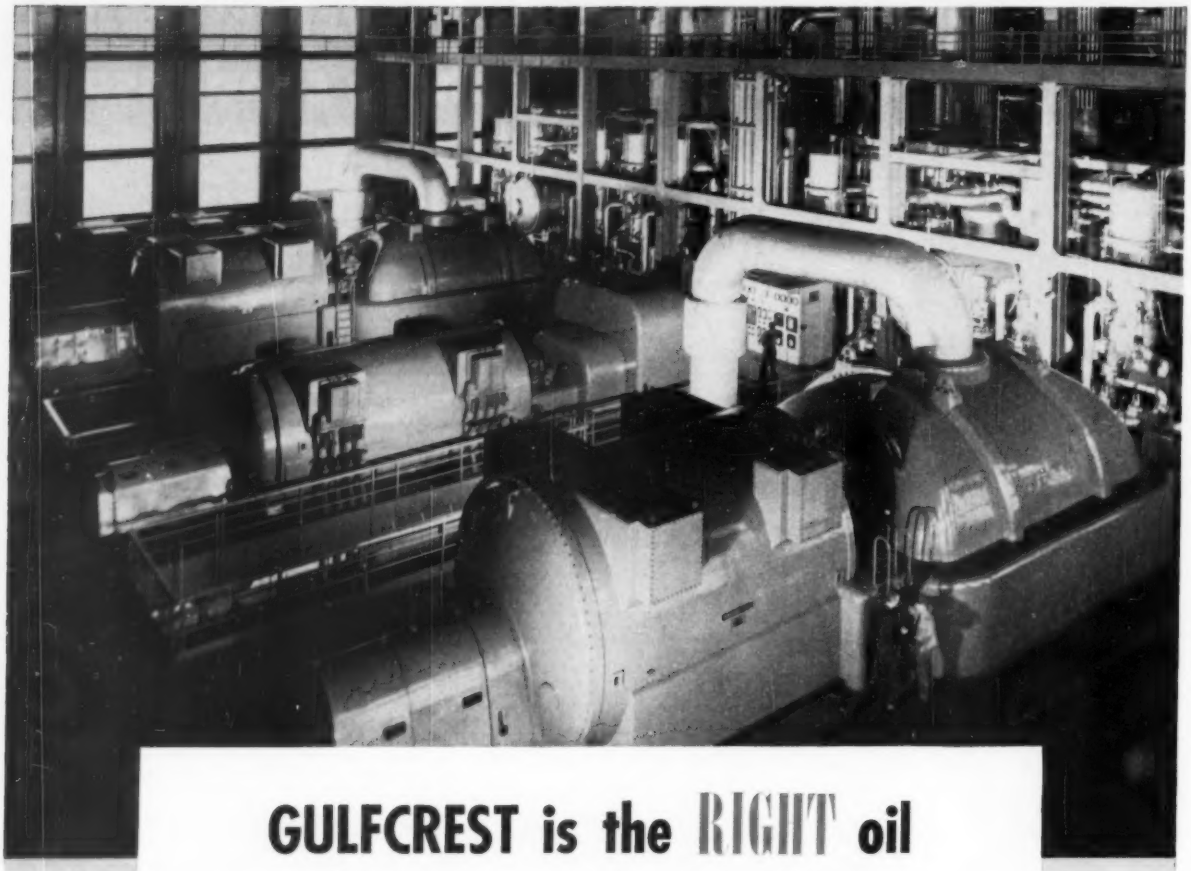
Typical of the outstanding steam turbine generators lubricated with Gulfcrest Oil are these two 168,750 kw. Westinghouse Cross-Compound turbines at the Southwark Electric Generating Station of the Philadelphia Electric Company.



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the RIGHT combination and concentration of additives

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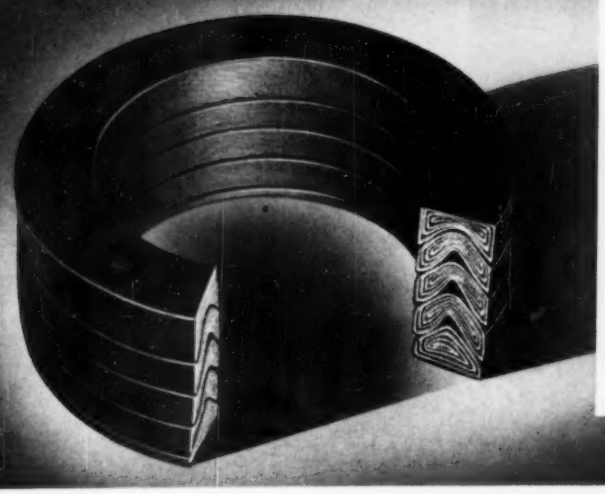
What is your special packing problem?



- ☐ Pressure
- ☑ Maintenance
- ☐ Acids
- ☐ Alkalis
- ☐ Complicated inventory
- ☐ Temperature
- ☐ Petroleum products
- ☐ Food products

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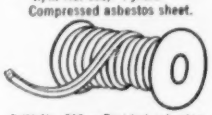
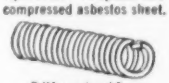
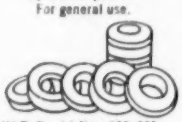


R/M No. 303 — Braided asbestos packing with monel wire.

R/M K-68 — Neoprene and compressed asbestos sheet.



R/M versi-pak® — For general use.



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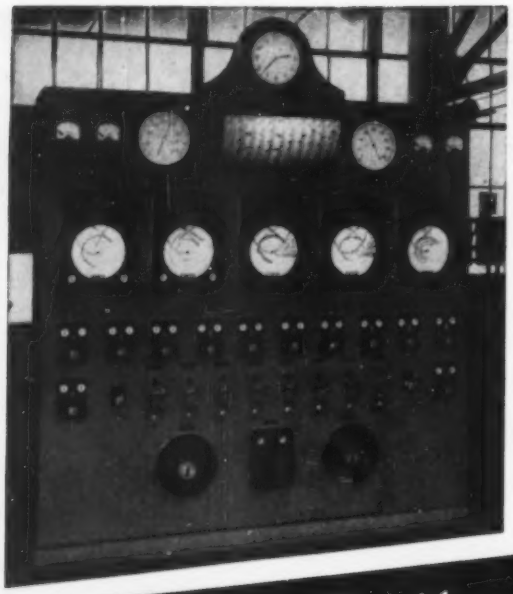

This Bailey Boiler Control Panel in a mid-western industrial plant saves fuel and insures safe operation of a 100,000 lb per hr, 175 psi, sat., pulverized coal and gas-fired boiler.

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TEMPERATURE · PRESSURE
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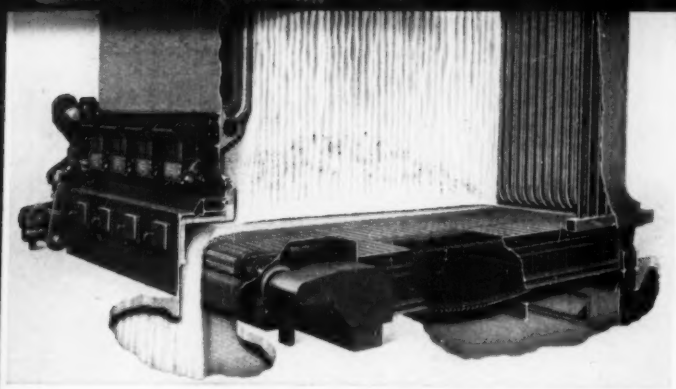

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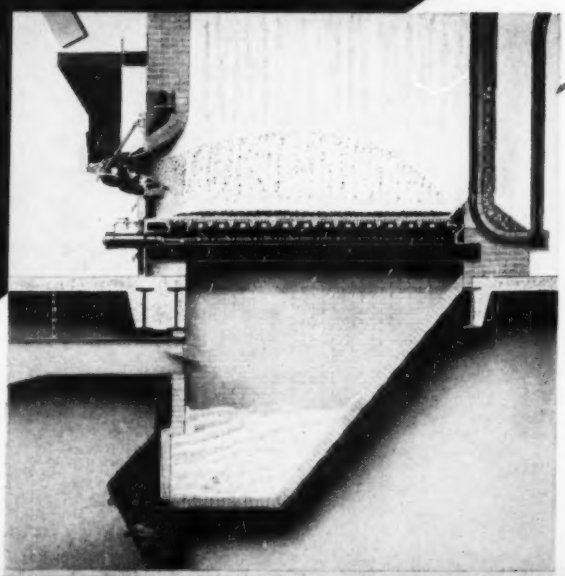
BE READY TO BURN A WIDE RANGE OF FUEL



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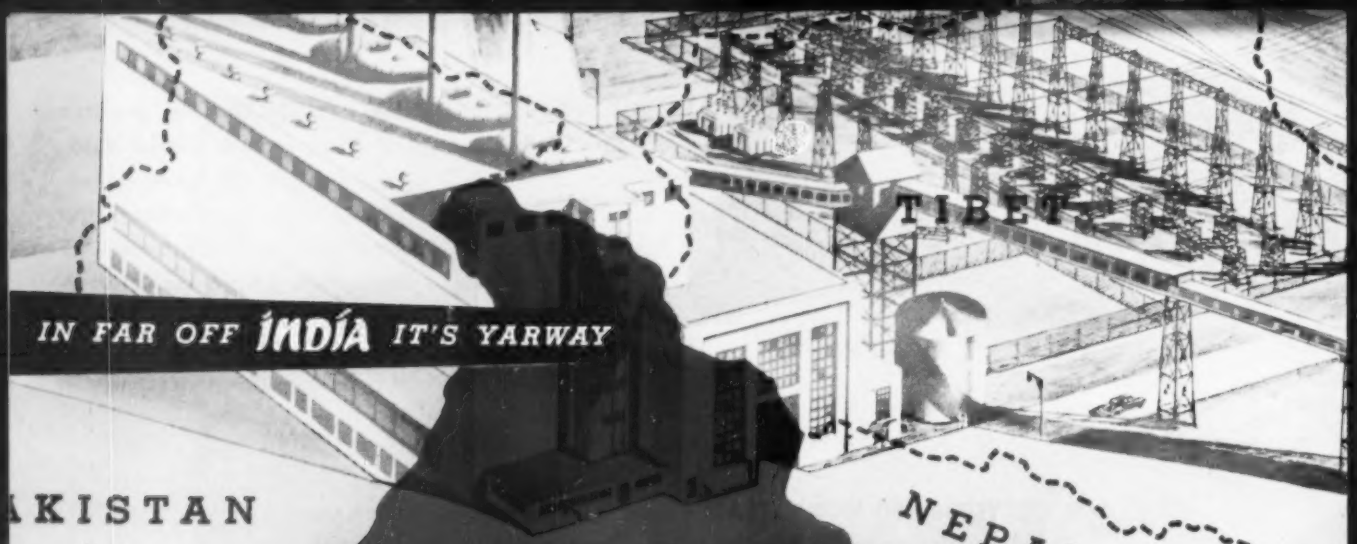

BOKARO STATION WILL USE 24 YARWAY UNIT TANDEM BLOW-OFF VALVES

India's great new Bokaro Station — the largest steam power plant in the Far East — will have its eight 300,000 lbs. per hour steam generating units equipped with Yarway Unit Tandem Blow-Off Valves.

Bokaro was engineered and constructed by The Kuljian Corporation — who know that the good design, quality materials, and careful workmanship of Yarway Blow-Off Valves mean *dependable service*, so important in modern power plants. That is why *4 out of 5 high pressure boiler plants today are equipped with Yarway Blow-Off Valves.*

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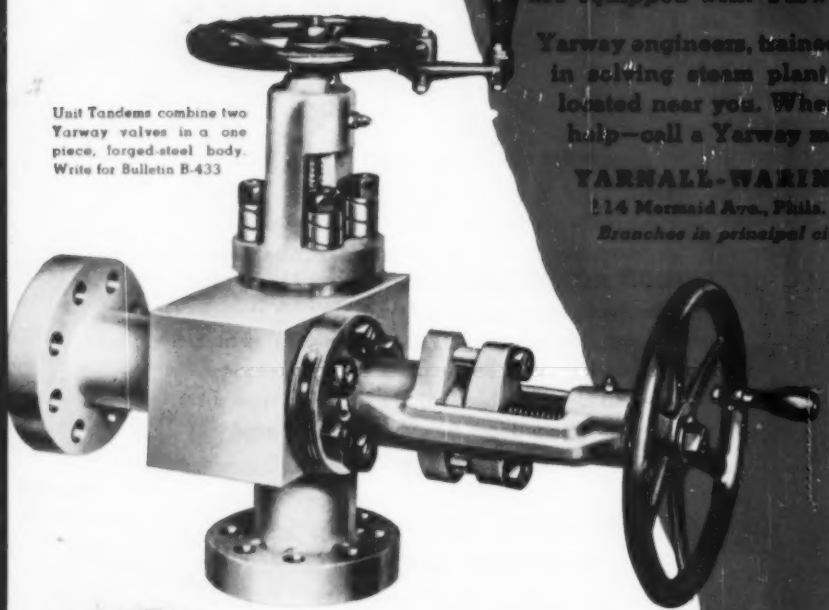
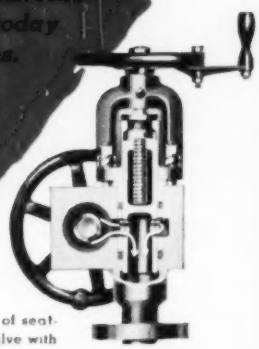
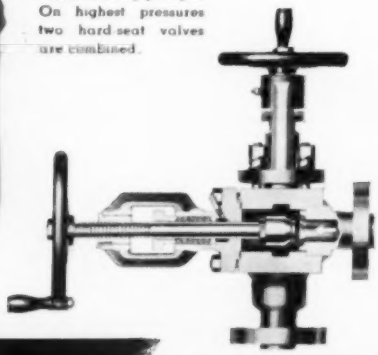


Unit Tandems combine two Yarway valves in a one piece, forged-steel body. Write for Bulletin B-433



Cross section of seatless sealing valve with famous Yarway balanced sliding plunger. On highest pressures two hard-seat valves are combined.

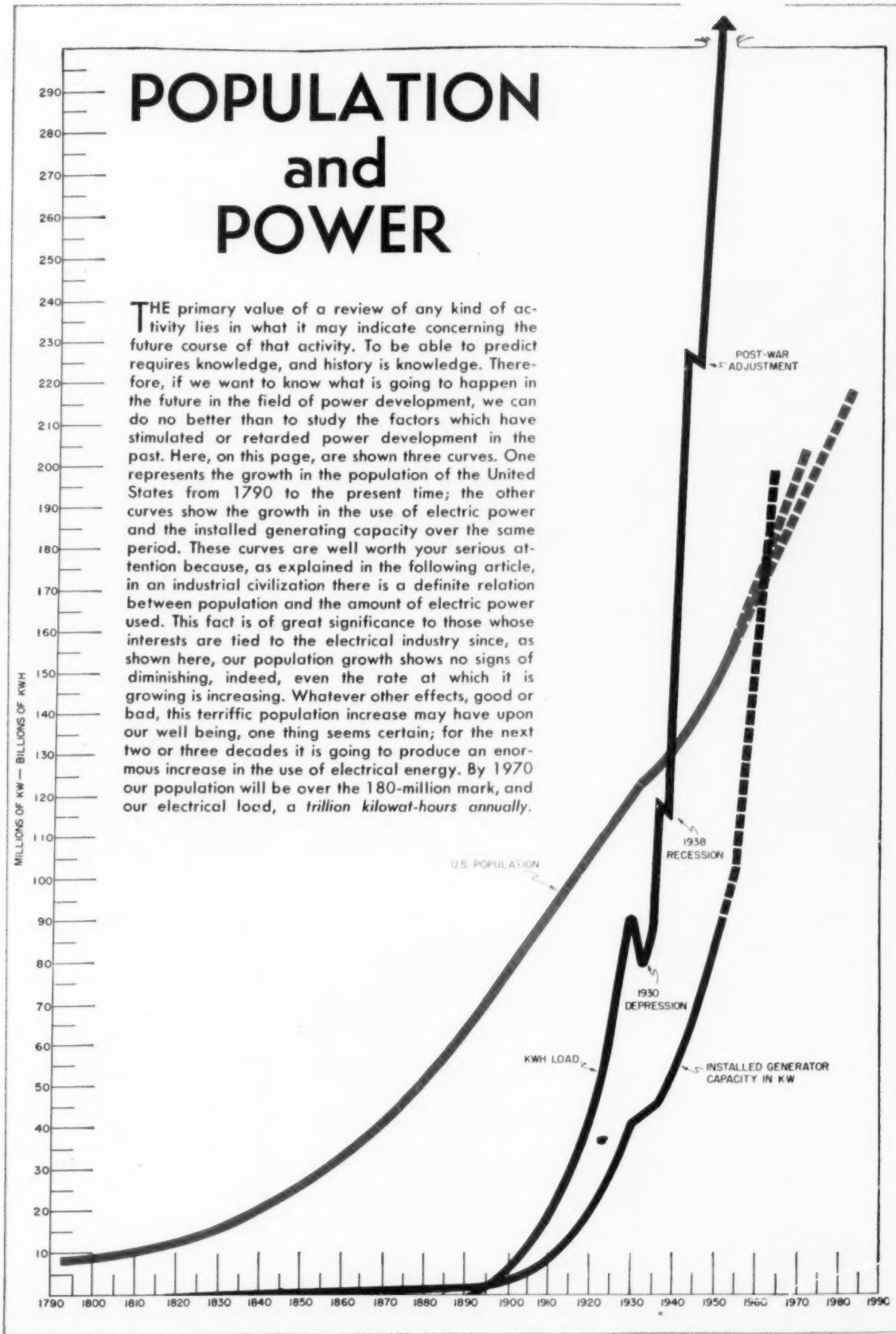


Cross section of hard-seat blowing valve with mated stellite-faced disc and integral welded-in stellite seat.

. . . YARWAY SERVICE GOES ALL THE WAY

POPULATION and POWER

THE primary value of a review of any kind of activity lies in what it may indicate concerning the future course of that activity. To be able to predict requires knowledge, and history is knowledge. Therefore, if we want to know what is going to happen in the future in the field of power development, we can do no better than to study the factors which have stimulated or retarded power development in the past. Here, on this page, are shown three curves. One represents the growth in the population of the United States from 1790 to the present time; the other curves show the growth in the use of electric power and the installed generating capacity over the same period. These curves are well worth your serious attention because, as explained in the following article, in an industrial civilization there is a definite relation between population and the amount of electric power used. This fact is of great significance to those whose interests are tied to the electrical industry since, as shown here, our population growth shows no signs of diminishing, indeed, even the rate at which it is growing is increasing. Whatever other effects, good or bad, this terriffic population increase may have upon our well being, one thing seems certain; for the next two or three decades it is going to produce an enormous increase in the use of electrical energy. By 1970 our population will be over the 180-million mark, and our electrical load, a *trillion kilowat-hours annually*.



Population Growth and Its Effect

Population growth is a primary factor in the continual increase in the use of electrical energy in the U. S. Depressions, recessions, and war seem to be of secondary influence. By 1970, the electrical load is expected to reach a trillion kilowatt hours. Reserve generating capacity now 9.3 per cent, will rise to 17 per cent by end of 1955

By ANDREW W. KRAMER

Editor, POWER ENGINEERING

EVERY TWELVE and a third seconds, in this great land of ours, our population increases by one person; 4.8 every minute, 292 every hour, 7000 every single day of the year! These figures, keep in mind, do not represent all the new babies; they represent the amount by which our population *grows* every hour or day. They represent the excess of births over deaths plus a small immigration quota. In a year the increase amounts to 2,560,000.

On September 1, 1952, the population of the United States was 157,505,000, an increase since the general census in April 1950 of 6,373,000 or 4.2 per cent. This increase indicated a yearly growth of 1.7 per cent, compared to 1.4 per cent per year in the decade from 1940 to 1950. Thus, it is seen that not only is the population increasing but the rate of increase also is still rising.

This rate of increase, as may be seen from the curve on the preceding page, has been going on for a long time, since around 1870. Before that, it was smaller. Note that the curve was far less steep during the period before 1870.

Factors in Population Growth

Many years ago Thomas Robert Malthus put forth his famous theory of population growth. He held the view that population, when unchecked, increases in a geometrical ratio while subsistence only increases in an arithmetical ratio. Also, he stated that population always increases up to the limits of the means of subsistence and that it is prevented from increasing beyond these limits by the positive checks of war, famine and pestilence, and by the influence of misery and vice.

The Malthusian theories have been the subject of much controversy during the years, and they have required certain modification, but, their basic soundness has never been successfully challenged. There can be little argument that population is, must be, related to the available food supply.

Our food supply, however, depends upon many factors besides mere tillable acreage. Man has been able to increase both tillable acreage and the yield from this acreage, and his development of skills in this direction have at times made sudden changes in the rate of population growth.

Primitive man lived by virtue of what unaided nature provided for him. In his advancement towards civilization he, successively, developed certain aids which more effectively enabled him to cope with the rigors of an unsympathetic environment and so gave him a greater chance of survival. The use of fire, his invention of the spear and later the bow and arrow, his domestication of plants and animals, the art of weaving and basketry, pottery, the use of metals, all helped him to survive and thus increase his numbers. Of these significant steps in human progress each was greater than the preceding and the effect was cumulative. The effect of none has been greater, however, than the two (not mentioned above) made in what we term historic times, both of which have to do with *power*. The first of these was the use of expanding gases as a source of power which began the *machine age*, and the second involving the electrical transmission of power brought in the *power age*. It is important to distinguish between these, since growth in the availability and use of power due to electrical transmission has resulted in changed social and economic conditions which have greatly influenced population growth. Before the machine age, man's tools — the wedge, the screw, the lever, wheel and spring — were associated with the use of muscular energy. The notable exception was the use of wind power to replace manpower primarily for boat propulsion. This had a tremendous influence on standards of living and distribution of population. By its use the Phoenicians rose to a dominant place in the world trade, trade expanded, human relations diversified, the Americas became part of a world economy.

Mastery of Expanding Gases

Then came the mastery of expanding gases. First gunpowder to force a projectile (piston) to a distance; next attachment of a rod to the piston to convert linear motion into rotary motion; then the application

on Future Power Development

of vapors and explosive fuel mixtures to driving the pistons. All this took much time and experiment but in its development lay the foundation of the machine age.

With these thoughts in mind it is of interest to study the curves of population and power growth on the preceding page. As already pointed out, previous to around 1860 or '70 the slope of the population curve of the United States was considerably less steep than it was afterward. What caused this change in rate of growth? The clue to the answer to this question lies in the two other curves, one showing the installed kilowatt generator capacity in the country and the other the electrical consumption. It will be

noted that both of these curves began to rise about 1890. Before that, however, a small amount of mechanical power had been developing. The steam engine had come into use during the early years of the 19th century but manufacturing facilities were poor and it was not until the middle of the century that its effect was noticeable.

Then it began to change the country from a purely agricultural economy to an industrial economy. The textile industry developed, machine tools came into greater use, the development of steam railroad systems stepped up transportation facilities. Finally, on September 4, 1882, Thomas Edison's Pearl Street Station first began supplying electric power for lighting incandescent lamps, and another new era was ushered in — the era of electrical transmission of energy.

Before the electrical transmission of power, the use of steam power had comparatively little direct effect on improving living conditions but the standard of living rose because of the availability of factory products and the rapid transportation of goods and people. With the development of electrical transmission, however, the organization and arrangement of factories was revolutionized; power became available for small factories at widely distributed points, and on farms. Production of goods and food increased enormously and still more rapid means of transportation brought it to within reach of countless more people. Developments in electrical communication stimulated the whole proceedings. Application of power to improve living conditions

became available in offices, shops, institutions, and homes, bringing a complete reorganization of methods and standards of living, which in turn resulted in lowering the death rate and increasing the birth rate.

Power and Population

The use of electric power, therefore has a definite bearing on population growth, and conversely, population growth has a definite bearing on electric power consumption. By and large, the electrical load curve follows the population curve. Depressions, recessions, wars, national disasters, etc. affect it but little and then only temporarily. This will be evident from the minor dips representing the 1930 depression, the 1938 business recession and the post-war readjustment period. For a short time there were slight downward movements in the use of electricity but the recovery was quick and the effect on the over-all increase was negligible.

The war, of course, stimulated the use of electricity but in view of the steepness of the growth curve after the war, it is doubtful whether the war was very much of a factor in the rate of growth. When we consider the fact that on April 1, 1950 our population was over 19 million greater than it was on April 1, 1940 — just ten years before, it is quite obvious that population is perhaps the most vital factor in our steadily increasing use of electricity.

Population alone, however, does not reflect itself in the steep rise in the electrical load curve unless it

occurs in a highly technical type of economy such as ours. As Dr. Vannevar Bush has pointed out, if population tends to expand exponentially, so does technical development. Each new technical idea breeds others. Each new use of electricity points the way to still others. This is why the electrical load curve rises at a very much higher rate than the population curve. Indeed, the expansion of the electric power industry is unparalleled. From 1922 to 1951 the consumption of electric power has increased by 7 per cent annually compared to a 3 per cent annual rise in over-all national production. At the present time this rate of increase in the use of electrical energy is close to 8 per cent.

At present we are using in the United States close to four billion kilowatt hours a year. As pointed out by B. L. England, President of the Edison Electric Institute during the year, we are now thinking in terms of a *trillion kilowatt hours in 1970*. If the present rate of population increase continues by 1970 there will be somewhere in the neighborhood of 190 hundred million people in the country, some what less probably. Just how far we can extend this population curve in the United States cannot be predicted with any degree of certainty. Our density of population is far below that of other regions of the world but density of population depends upon many factors. According to Ellsworth Huntington, climate rather than soil determines density of population. He cites the rice producing countries, China, Japan, Java, as examples. Rice requires a warm damp climate, and wherever rice has been introduced into lands with such a climate population has become dense. Rice culture is capable of producing more food per acre than any other type of agriculture. There are also the industrial countries and, as Ellsworth Huntington has pointed out, they lie mostly in regions with temperate climate, neither too hot nor too cold

and at the same time of a stimulating nature. A stimulating climate is what is required in order that man should engage in industrial activities.

Even the warm damp areas of the United States are not given over to rice culture, but, we have the stimulating climate needed for industrial activity and that together with our abundant natural resources, of course, is one reason for our continued growth. Just how many people the United States can reasonably support within its boundaries, can only be guessed at but it is quite probable that the figure can go well above the 200 million mark.

It is inevitable, therefore that the demand for electrical energy will continue to increase as the population grows. Whether the load will reach the estimate of 19 trillion kilowatt hours annually predicted for the year 2000 by Dean G. W. Gleeson of Oregon State College last year is something that we cannot speculate on now without having better crystal balls at our command than we have. It is quite sufficient, however, for us to be able to look ahead some 18 or 20 years, and that we can do with reasonable certainty as far as the electrical load is concerned.

Automatic Control

The extremely rapid rise in our use of electricity compared with the slower rise in our population brings into perspective the increasing importance of automatic operation and control. The sheer magnitude of the plant required to furnish these enormous quantities of electrical energy, let alone the electrical equipment necessary in its utilization, will make it impossible to provide enough skilled operators to control it manually. The utilities are experiencing difficulty in getting adequate personnel even today. As stations have become larger, the number of operators per kilowatt installed or per kilowatt hour delivered has become steadily smaller. More and more of the operations are becoming automatic and the personnel is on hand largely in a supervisory capacity — to take over control in case of failure of the automatic equipment. Indeed, even the function of trouble shooting is being taken over by automatic devices, as in the case of SARA at the Johnsonville plant of TVA. This is an electronic trouble shooter, technically known as the Sequential Automatic Recorder and Annunciator. It was devised to provide split-second trouble shooting in the complicated electrical mazes of modern power plants. The practice of hooking up a large number of vital operating points to a common central control board, of course, has been conventional practice in power plants for many years. While a central control board is a great advantage it is scarcely adequate in preventing trouble when an important device fails. Such a failure may set up a whole sequence of events, so fast, that the disturbance manifests itself as one big flash. This is where SARA comes in. It can detect as many as 400 types of occurrences and it reports and records when and where conditions occur and when operations are restored to normal. SARA, indeed, is a sort of electromechanical newspaper, complete with reporters, editorial desk and complete automatic printing plant.

This electronic device at the Johnsonville plant may be regarded as the forerunner of a great many similar devices that are going to be installed in the power plants of the future. Thus far, the power plant industry has made only limited use of electron tubes but new systems of control are coming into use which use not only electron tubes to an increasing extent but also the new magnetic amplifiers. Undoubtedly the transistor also will find application in industrial power control systems. System analyzers and computers of various types also are coming into use more and more on power systems both for load studies as well as operation. Systems are becoming so large that only by the

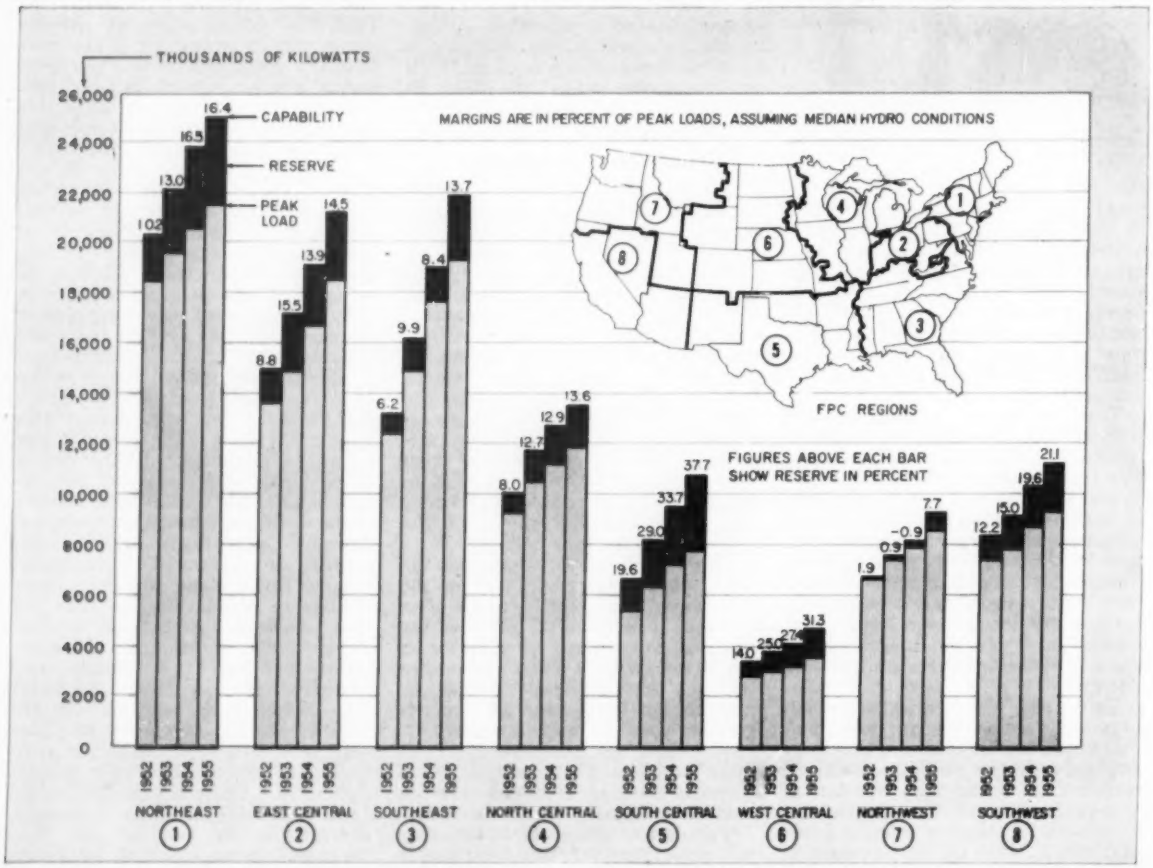


Fig. 1 This chart shows reserve electric generating capacity in the various Federal Power commission regions in the United States during the next four years

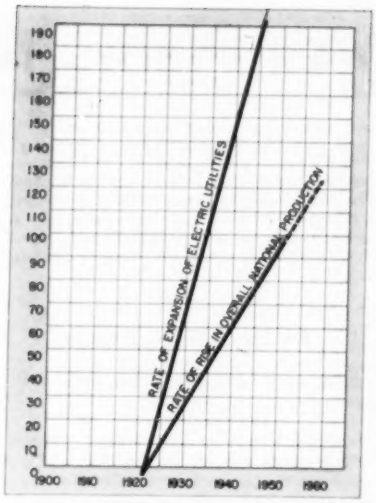


Fig. 2 From 1922 to 1951 the consumption of electric power has increased by 7 per cent annually compared to a 3 per cent annual rise in overall national production of the United States

use of computers will it be possible in the future to properly allocate machines for most efficient operation.

This steadily increasing trend toward the use of automatic control and the use of electronic equipment in the power field will make it necessary to develop men with quite different training than that of operators now in charge of our power plants. Their first qualification will be a thorough understanding of basic engineering principles, coupled with a wide and diversified experience with automatic controls. More than that, they will have to be familiar with all aspects of economic operation and maintenance of power equipment, since the investment in the latter will make it imperative to operate it at its most efficient rating at all times. A million dollar boiler cannot be shut down for any appreciable time in the course of normal operation. Nor can it go unattended; such a boiler will run dry in about 90 seconds if the feed water supply were cut off.

Reserve Generating Capacity

As far as the immediate future is concerned the trend in power development is toward still larger steam generators and electric generating units. Also, there is expected to be a slow but steady increase in both the national reserve capacity and the national annual load factor. As predicted in the Edison Electric Institute's 12th Semi-Annual Electric Power Survey, this year our reserve generating capacity will be 9.3 per cent. As shown by the accompanying chart, the reserve capacity in most sections of the country is good except the Northwest. In that area, the reserve this year is less than 2 per cent, and even this is expected to drop in 1953 and 1954. Because of this very slight margin of generating capacity over the load, on October 30, the Defense Electric Power Administration ordered a 10 per cent curtailment of firm loads. This move was made in order to maintain reservoir levels for the operation of the vast Northwest Power Pool throughout the winter.

During the next three years, according to the EEI, the national reserve will gradually rise to a value of 17.1 per cent at the end of 1955. By that time the installed capacity will reach a value of around 118 million kilowatts.

Atomic Energy

None of the current predictions concerning the continuing growth in the use of electrical power are based on the possible use of atomic energy in the years to come, yet, atomic energy is a factor that is already making its influence felt, not in the production of power but in its use. As is now well known, certain of the processes in the production of fissionable materials require great quantities of both steam and electrical energy. Indeed, the amount of electrical energy needed is so great that a number of special plants are under construction to supply it. As described in the September and November issues of POWER ENGINEERING in Southern Illinois and in Kentucky two plants which will have a total capability of over two million kilowatts are being built, these are the Shawnee plant of TVA and the Joppa plant of Electrical Energy Incorporated. These two plants will supply the new uranium refining plant now under construction by the Atomic Energy Commission near Paducah, Kentucky.

A similarly large project of the same general nature is being started in Ohio. There about 6500 acres are being acquired in Pike County for the new gaseous diffusion plant of the AEC. Goodyear Tire & Rubber Company will operate this plant. Power for the project will be supplied from new generating stations and from the existing systems of 15 companies sponsoring the project. These 15 private power companies have formed a corporation known as the Ohio Valley Electric Corporation and will supply the 1,800,000 kw needed to operate the diffusion plant. This will be the biggest chunk of power supplied to any one user anywhere on earth. Federal Power Commission officials say that the total involved will be nearly two and a quarter million kilowatts by the time of completion.

All this power activity resulting from the atomic energy program is, of course, on the negative side, that is, power is *used* to produce atomic energy. There is, however, a great deal of active work being done toward the design of atomic power plants. The generation of electricity from nuclear energy is closer than most engineers could have foreseen, even two years ago. Instead of discounting the possibility of developing atomic power plants on an economic basis in the foreseeable future as they were inclined to several years ago, utility engineers are now actively interested and five separate groups involving utility and industrial organizations have been formed to make detailed studies of the problem.

As described in the February issue of POWER ENGINEERING, an experimental atomic power plant went into operation at the National Reactor Testing Laboratory in Idaho on December 20, 1951. A Diagram of this plant is shown in the following pages. In this system, heat is abstracted from the reactor by means of a liquid metal, a sodium-potassium alloy. This has a temperature of 660 F at the reactor exit and it generates steam at a pressure of 400 psi.

This experimental plant proves that power can be generated by means of nuclear energy but it does not prove that it can be done on an economic basis. A great amount of

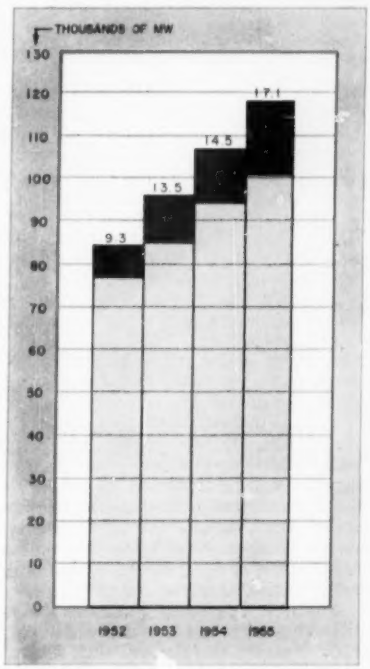


Fig. 3 Predicted reserve generating capacity for the United States during the next three years

experimental work on the problem is, however, in progress and there can be little doubt that the problem will be solved and that in the relatively near future, we shall see a large atomic power plant under construction. Just what part atomic power will play in the future power development of the nation, no one can say at the present time. When one considers the fact that 20 lb of uranium at an assumed cost of $700 is equivalent to some 26,000 tons of coal, it seems quite likely that despite our immense coal resources, atomic energy will play an important part in the future of power.

Bigger and Better Power Plants to

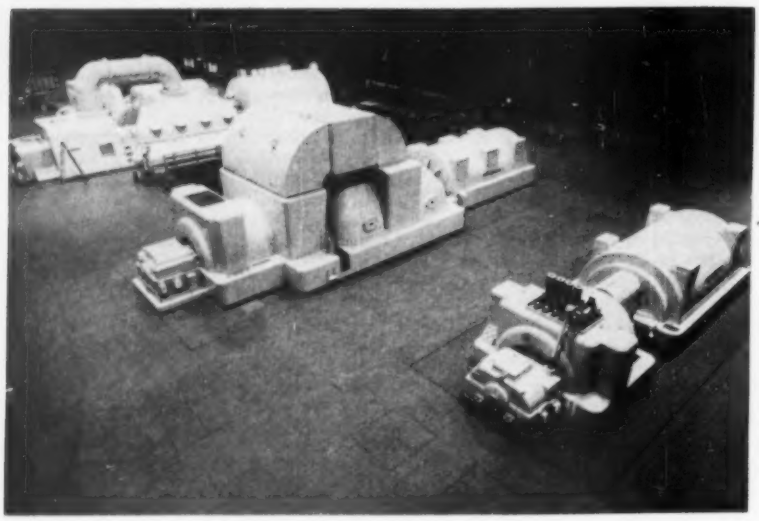


Fig. 1. Two of the first 150,000-kw (nominal rating) cross-compound turbine generators at Ridgeland Station, Chicago. Unit farthest away was installed first, dedicated in December 1950 (See January 1951 issue). This view was taken recently and it gives reader some idea of size of modern units. Each turbine is served by two cyclone-fired boilers

By CHESTER R. EARLE

Managing Editor, POWER ENGINEERING

BIG THINGS have been accomplished in power engineering in the past few years. Population growth and the relation of this to the climbing power demand curve has been explained in the preceding article.

The power industry, accurately forecasting the demands, moved with resolution and dispatch, as the record of the last few years shows. Today we are witnessing some of the results.

Larger Units: — This year, for the first time, single steam turbine generator units of 200,000 kw capacity are under construction, scheduled for operation in 1953. A large proportion of all new utility turbines, about 19,000,000 kw, according to one authority, will be designed for reheat.

In most cases, utility units are one-boiler-per-turbine. We are seeing single boiler units of up to 1,400,000 lb of steam an hour under design and construction to serve the turbines.

Furthermore, one unit has been announced to operate at 2350 psi, 1100 F steam conditions, with reheat to 1050 F and at least 60 other large units, ranging in capacity from 60,000 kw to 150,000 kw are built or in operation for steam at 1000 or 1050 F. Nearly all these reheat 1000 or 1050 F.

Initial steam pressures go up to correspond, highest so far is 2350 psi.

While many of the new large units are single-shaft 3600 rpm machines, many others are cross-compound. One manufacturer is designing single-shaft 3600 rpm machines up to 200,000 kw and plans to go higher if required.

Reasons for the big steam generators and turbine generators are two-fold: — A. the well-known thermal and economic efficiencies of the large units, B. the relation of 1 unit capacity to system and reserve capacity in operation of growing utility systems.

Numerically, there are more 60,000 kw and 100,000 kw turbine generators being planned than in the other sizes. Many units are of the Preferred Standard type and there is discussion of including 150,000-kw units.

As noted last year, 18 high pressure controlled circulation steam generating units are on order; one of the earliest to be under erection is that shown in Fig. 4. These units range in rated output from 750,000 to 1,450,000 lb of steam per hour, each employs reheat, each serves a single turbine generator.

Industrial Boilers: — As the demand for industrial electricity increases, and as more and more of it is supplied by the utilities, the need for industrial boiler plants to supply it increases also.

About three-quarters of the industrial boilers being installed today are in the capacity range below 50,000 lb per hr capacity and for pressures of 300 psi or less, supplying steam for heating and process.

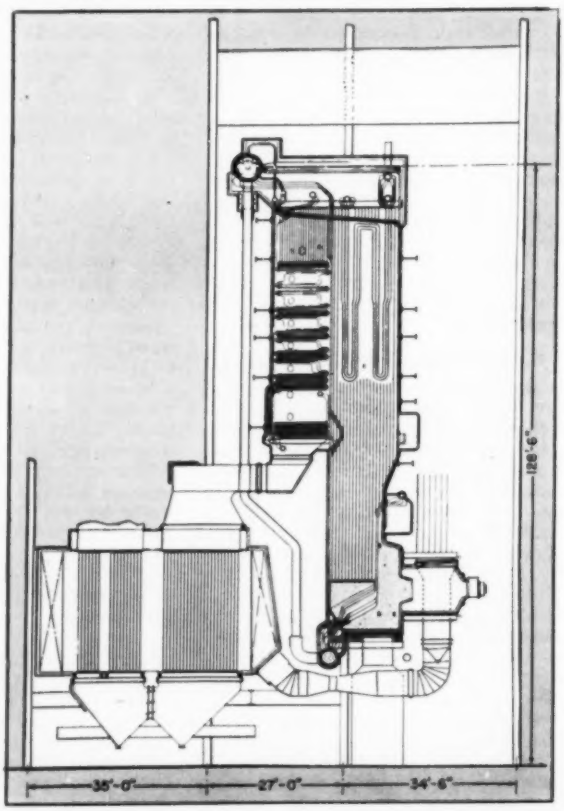


Fig. 2. One of latest cyclone-fired radiant steam generators, for 1,200,000 lb per hr continuous output, with radiant-convection superheater. Design pressure 2125 psi, 1050 F primary and 1000 F reheating temperatures. Cyclone firing was developed in effort to minimize fly-ash problems, reduce carbon losses, handle coals containing considerable ash and pyrites, and reduce induced draft fan maintenance. Of 31 cyclone units designed, 20 are now in operation

Meet Soaring Demand Economically

Power Engineers are using these methods to build bigger and better power plants:

1. **Boilers up to 1,400,000 lb per hr each**
2. **Turbines up to 200,000 kw capacity each, with talk of building 250,000 and even 300,000-kw units**
3. **Great increase in use of reheat units**
4. **Increase in steam pressures up to 2300 psi, steam temperatures to 1050 F and in at least one case to 1100 F**
5. **Use of outdoor and semi-outdoor plants**
6. **Centralization of controls to lower operating expense**
7. **Attention to details of design and maintenance has improved reliability and improved maintenance scheduling, reduced spare equipment investment**
8. **Gas turbines for power generation, pipe line pumping, railroad locomotives**
9. **Planned large pumped storage hydroelectric projects: —Flatiron, Hiwassee, Niagara and large underground plants**
10. **Combined forces to advance the work on atomic power plants materially**

There is no lessening of the interest of many thousands of industries in generating their own power with turbine generators supplying extraction and exhaust steam to processes. But the increasing use of electricity for process machines often makes it difficult to get the steam-electric balance that make industrial power generation economically. Hence a larger proportion of the electricity is being supplied by the utilities.

Fuels: — In spite of the warnings that we are exhausting our oil and gas resources, the petroleum industry keeps on supplying ever increasing amounts of oil and natural gas for industrial fuels and assures us there will be no oil shortages.

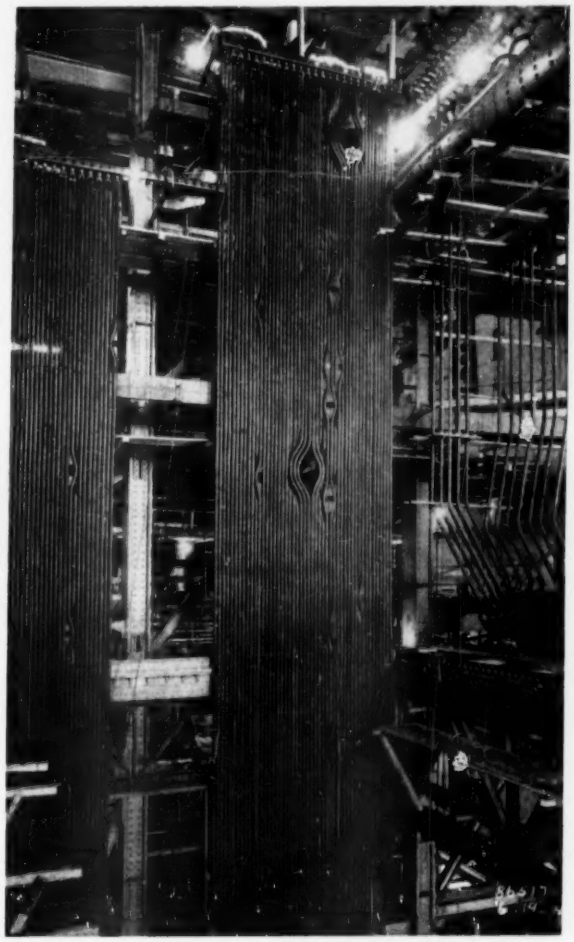


Fig. 3. After a steam generating unit is installed, many people have no idea what its internals look like; and if it is installed indoors, it is practically impossible to see the complete unit. Here, however, is a view of furnace wall tubes under erection in one of the giant steam generating units of the Consolidated Edison Company of New York

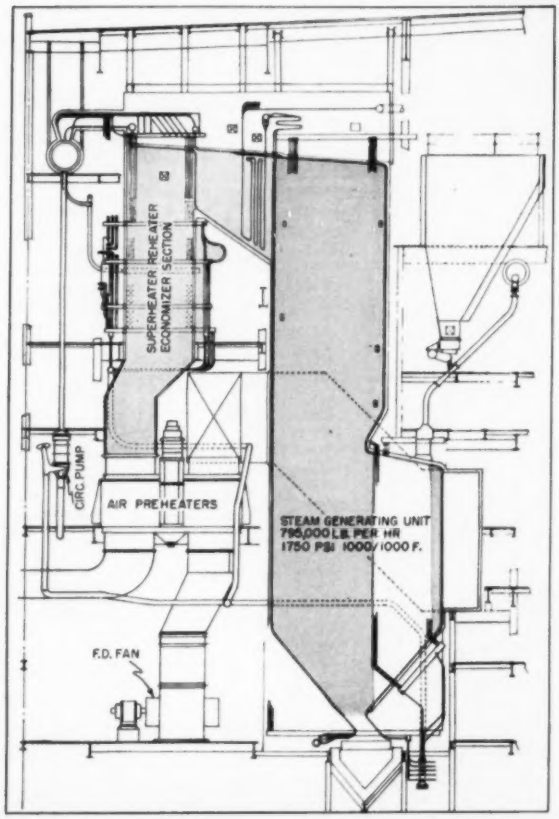

SUPERHEATER REHEATER ECONOMIZER SECTION
CIRC PUMP
AIR PREHEATERS
STEAM GENERATING UNIT 795,000 LB. PER HR 1750 PSI 1000/1000 F.
F.D. FAN

Fig. 4. This controlled circulation steam generator, designed for 795,000 lb per hr at 1750 psig, 1000/1000 F, will soon go into service at Oak Creek plant in Wisconsin. Adequate water circulation is assured by 2 of 3 single-suction constant-speed motor-driven pumps, suspended in piping as shown. This unit supplies a single 120,000-kw cross-compound turbine generator. Make-up water will be supplied by a demineralizer. (See July 1952 issue, page 56)

Natural gas is being burned wherever the pipe lines can supply it throughout the industrial sections of the entire country. Often it must be on a dump basis for industry.

There is much interest in burning waste fuels; and many plants burn waste wood, bark and the like on spreader stokers. In steel mills, there is a growing tendency nowadays to burn blast furnace gas as a base fuel.

Coal continues as usual to be the base fuel for utility and industrial steam and power generation. All forms of stokers and pulverized coal equipment are constantly being improved.

Furnaces: — Use of the adjustable furnace, the cyclone furnace and the divided furnace is continuing. Pressurized operation, developing during the past years is now a reality. Re-

Steam Temperature Control—Auxiliaries

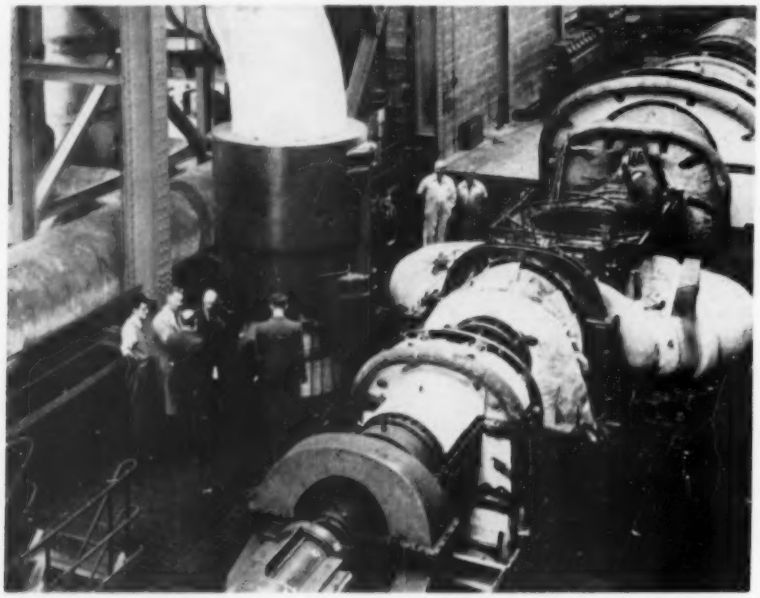


Fig. 5. Gas turbine of 10,000-kw capacity in an experimental plant in a station of the British Electricity Authority at Manchester, England. Heat-exchanger unit is shown dismantled after completing a trial run

circulation of flue gas into the furnace is another recent development.

The cyclone furnace burns crushed coal, oil and gas and has lower coal preparation costs. It is designed to trap fly ash in the molten slag and discharge it before it passes through the boiler. It operates under pressure and 20 units are now in operation.

Steam Temperature Control: — As boiler steam temperature rises to 1050 or 1100 F, much more attention than formerly must be devoted to controlling steam temperature accurately in boilers and piping.

The adjustable furnace uses tilting burners to attain a large measure of this control. Divided furnaces with separate burners for superheat control have also been used in a number of cases. Another feature claimed for the divided furnace is that it reduces total volume of the steam generating unit, as shown in Fig. 7.

Basic methods of controlling boiler steam temperature include combinations of radiant and convection superheaters, use of attemperator and condenser type (both heat exchanger types) of controls and use of flue gas bypass dampers.

A recent development is recirculation of a suitable proportion of flue gas through the furnace as shown in Fig. 8. The recirculated gas, according to Kessler, is introduced into the furnace at a location such that it will not disturb the combustion processes. It provides a means of modifying the absorption of heat by the furnace walls, thus controlling the quantity of heat in the gases leaving the furnace and as a result, the heat available for superheating the steam.

Future trends in controlled circulation designs may lead to operation at pressures above 3200 psi (the critical pressure, at which steam and water densities are equal).

Pressurized Firing: — Objectives of pressurized firing are, briefly, to increase heat transfer, hence efficiency, reduce boiler metal, minimize gas quantities, reduce resistance to gas flow, eliminate induced-draft fan maintenance. In addition to the cyclone furnace units, several very large high-capacity, high-temperature boilers are installed and operated under pressure. Many smaller conventional units and "package" units are also designed for pressurized operation.

Recent reports indicate that, after correction of initial difficulties with certain auxiliaries and accessories, pressure operation has been successful.

Pressure operation is claimed to have many advantages — reduced auxiliary power, reduced fan maintenance, improved combustion air control, and furnace conditions and steam temperature control are among them — and improves station heat rate from 35 to 50 Btu per net kwh. Disadvantages include increased setting cost for leak proofing, difficulty with soot and slag blowers, difficulty with ash and slag removal.

Water Treatment: — Principal interest in water treatment, in both utility and industrial stations, still centers in the possibility of using deionization instead of the evaporator for preparing makeup water. Several large installations of this type have been made and operated successfully, as well as a number of smaller ones, the latter for treating both boiler feedwater and industrial

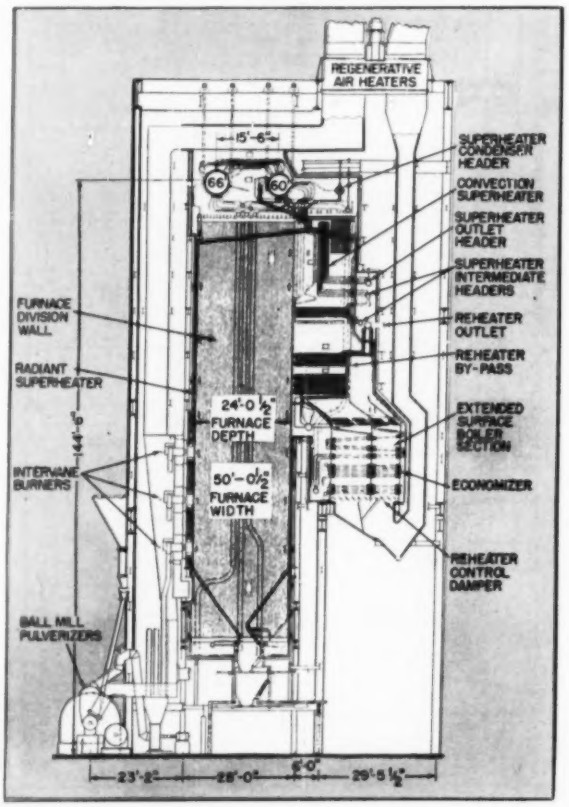


Fig. 6. Here is one of largest steam generating units now being constructed. It is a dual-circulation unit, 1,400,000 lb per hr continuous output; design pressure 2075 psi, primary steam temp 1000 F with reheat to 1000 F. It will be in the East River station, Consolidated Edison Company of New York. It will be fired with pulverized coal through sets of intervane coal burners

process water. These units all produce water containing undetectable traces of CO_2 and silica.

There is interest in the mixed-bed system where anion and cation resin exchangers are mixed in one tank, each performing its own function.

Gas Turbines: — Future of the gas turbine appears to be in utility and industrial applications up to about 15,000 kw, although some European gas turbine installations range up to 27,000 kw.

As of September 1952, two U. S. manufacturers had built, or were then building 23 gas turbine units for electric power generation with a total capacity of about 100,000 kw. About half of these are designed to fire natural gas, the other half for fuel oil.

On the coal burning locomotive gas turbine, on test at Dunkirk, N. Y. (May 1952 issue, page 56), the second 750-hr test run was completed and the unit was disassembled for checking. No further information has been issued on the results.

All generating units now installed and operating in the U. S. are of the simple open-cycle type, several of 5000 kw rating, equipped with regenerators; complex designs have been avoided, inlet gas temperature (designed) averages about 1340 F; the split-shaft type is popular.

Largest U. S. unit is a 15,000 kw, 1500-F unit now being built.

One manufacturer has on order 28 gas turbine compressor units for gas pipe-line pumping.

After three years and 23,000 hours operation of the natural-gas-burning turbine generator at Belle Isle Station, without service repairs, the second 4000-kw unit of similar construction has been placed in service there. These units exhaust through a heat exchanger that heats feedwater in steam turbine cycles in the station.

European gas turbine work is far ahead of ours. Foreign companies as of September were producing 42 gas turbines with a total capacity of 275,000 kw. They are building open-cycle, closed-cycle and semi-closed-cycle types. Units range from 750 to 27,000 kw capacity (largest in the world). Gas inlet temperatures are almost always below 1200 F, critical point of vanadium deposition.

Hydroelectric Giants

Hydroelectric:—Bigness is a trend in the hydroelectric as well as the steam power fields. Total installed U. S. Water power capacity is now about 31,000,000 hp, with 15,000,000 more in Canada.

Large size units are planned for several new developments. Two 48,-000-hp Francis turbines for 1040 ft head are being planned for the Flat-iron project, which will also have a large pump turbine unit. Kaplan and propeller type units of over 70,000-hp capacity are also being installed.

Of special interest is the plan to install at Hiwassee, in TVA, a reversible pump turbine (see October 1951 issue) in which the electric machine will have a rating as a motor of 102,-000 hp and as a generator, 70,000 kw, 13,800 v. The unit will have the largest Francis runner ever built.

Another very large development is the Alcan project for aluminum recovery in British Columbia. Here an underground power plant in solid rock will be designed to contain sixteen 150,000 hp vertical-shaft impulse type water turbines operating at 2500 ft head, largest in the world for such a high head.

Centralized Control: — In the field of power plant control we are directly concerned again with people. The tremendous units referred to above, and still larger ones planned, also the tremendous concentrations of 1,000,-000 or even 2,000,000 kw of capacity in one plant, now being planned, could not be thought of if their operation depended entirely on human

Fig. 8. Diagrammatic arrangement, according to Kessler, of steam temperature control by gas recirculation, showing fundamental principle employed

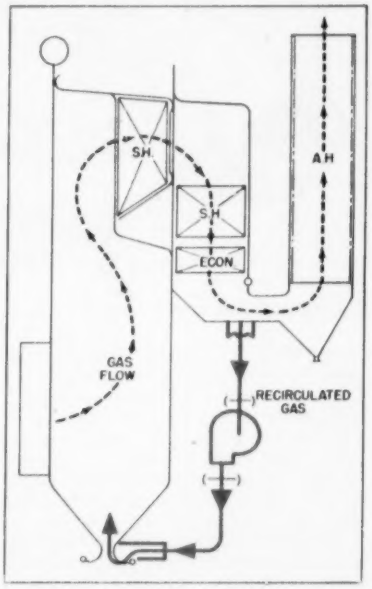


Fig. 7. Divided furnace construction, used in combination with pressure firing, gas recirculation and improved alloys and other features, has been used on 75 large units, 80 more under construction. This design reduces width for constant height and vice versa, reduces steel and materials, cuts the construction cost, and reduces furnace slagging

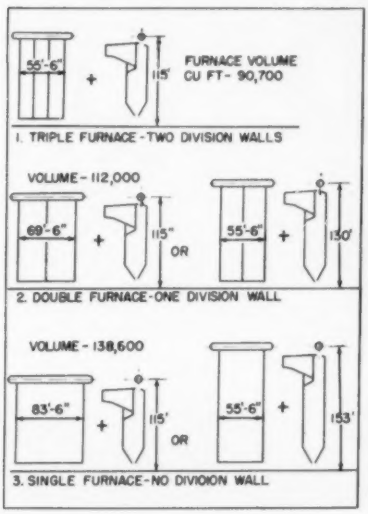
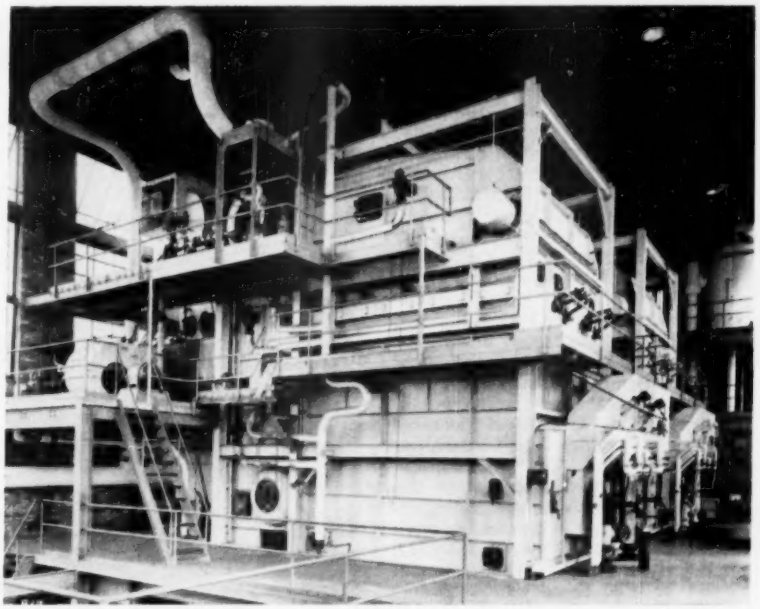


Fig. 9. Typical modern industrial boiler plant, for supplying process steam, contains two 50,000-lb-per-hr steam generating units. Many of these boilers operate at pressures of 300 psi or less to supply processes



"Comes the Revolution" in Power Plant Control

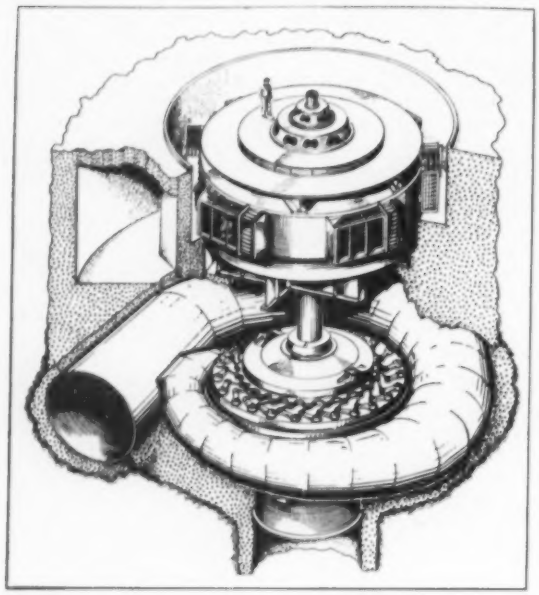


Fig. 10. Reversible pump turbine to be installed at Hiwassee Dam of TVA, will have largest Francis runner ever built. As generator, unit rated at 70,000 kva; as a motor 102,000 horsepower, largest built up to date

supervision of every detail and every repetitive operation. Instead, we have developed automatic control systems to a very high pitch to aid a relatively few operating engineers in performing the necessary adjustments. The idea is that the automatic control supplements the operator, but cannot supplant him entirely.

However, industry is now talking seriously about the automatic factory and is actually building electronic computers and "electric brains" for this purpose and actually has in operation certain production components controlled by these devices. In power plant work, too, the automatic devices are beginning to go far beyond the possibilities of the customary combustion, feedwater and pump controls. A system of load-frequency control in use in several stations distributes load swings as desired among a group of turbine generators that are operating in parallel. One utility is considering use of an "electric-brain" fed by a tape to issue master control impulses for an entire station.

In detail, the trend continued toward centralization of all power station controls in a single control room, both in housed plants and in outdoor plants. There is still debate as to how far this should go. Most engineers, however, agree with the trend towards providing the central operators with only the indications and adjustments they need for moment-to-moment operation and locating the historical recorders needed for calculation and trouble analyzing on separate panels. Even here, however, some engineers feel the operator should be able to see the recorders clearly to discern developing trends.

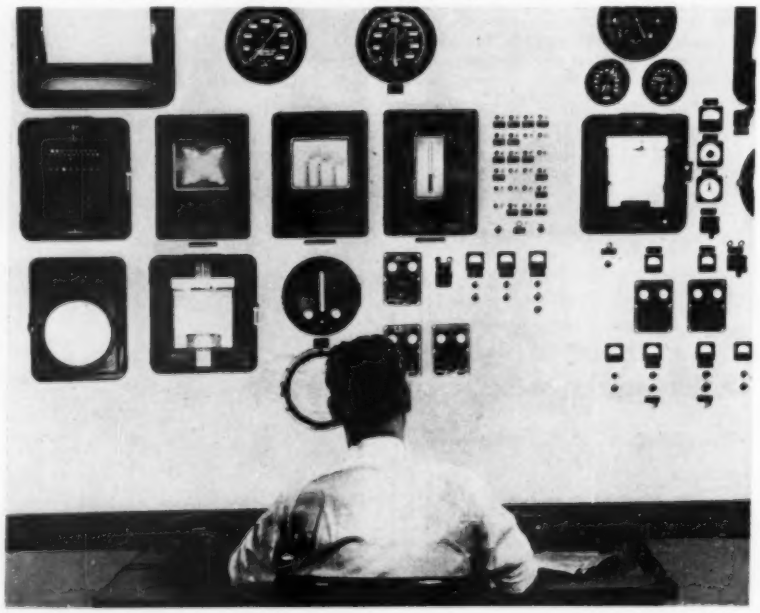
Use of diagrammatic panels and smaller and newer types of instruments to reduce size of control panels, is continuing since many types of transmitters, both electrical and mechanical, are now available. An idea for using small diagrammatic panels solely as an adjunct to standard control panels comes from Britain and is being studied here. Color coding of both electrical and mechanical instruments is still somewhat controversial. One of the great new helps in centralizing control is the use of wired television, Fig. 11.

Atomic Power: — Generation of electricity from nuclear fission, or "atomic power," is 10 years closer to us than it used to be. For some time, groups of utilities and industries have been working on the problem of developing nuclear reactors that would provide electric power. The first atomic power plant is now in actual operation in Idaho as chronicled this year in the February 1952 issue, page 54. This is a breeder type of reactor, in which experiments are being made to convert non-fissionable material into fissionable material faster than nuclear fuel is consumed.

The details of this power plant, which supplies electricity to its own installation, are shown in Fig. 12. The core of the reactor where the nuclear fission takes place is about the size of a football. The heat of the reaction is picked up by a liquid alloy of sodium and potassium, which is pumped by an electromagnetic pump through a heat exchanger. (See August 1952 issue, page 95.) This liquid metal is radioactive, so a second circuit of the same alloy picks up its heat in the heat exchanger but does not pick up radioactivity. The non-radioactive liquid metal is then pumped to a specially constructed steam boiler, where it generates steam to drive a conventional turbine generator. The installation is named EBR (experimental breeder reactor).

The liquid metal leaves the reactor core at a temperature of 660 F and in the steam boiler it generates steam at 400 ps; this steam drives a 250-kw turbine generator that supplies all the facilities at the reactor and the building in which it is housed. A

Fig. 11. Wired television in centralized control room of large station, shows control operator combustion conditions in furnace, tops of stacks, boiler water level, greatly increases ease of centralized control



Atomic Power Is Coming Closer Every Day

more complete description of this reactor was given in a recent review of the whole subject of power generation with nuclear reactors by Dr. W. H. Zinn, director, Argonne National Laboratory.

Rightly and naturally, all utility and many industrial power engineers are attacking the problem. Five great utility-industry teams are making specific studies.

First of all, will it pay? It is seen from Fig. 12 that the whole heat-generating end of the atomic power plant including the special boiler, is different; but from the turbine generator on, the plant is conventional.

In the above noted paper, Dr. Zinn analyses costs of uranium fuel, plant investment and other economic factors and shows that a complete 200,000 kw plant could be built for $80,000,000 including the necessary chemical processing. Since present steam plants can be built for much less than that, we still have some problems.

However, of the utility industry groups now working on the problem, at least two have discussed the economics publicly. The Detroit Edison-Dow group (recently joined by 11 other utilities) has stated that its studies show it could afford to spend $227 per kw for the nuclear reactor portion of an atomic energy power plant. This would be the upper limit, because if the initial investment exceeded this amount, cost of heat at the turbine throttle would exceed that from a conventional boiler plant. This assumes the cost of the nuclear fuel is zero. The nuclear part of the plant would replace only the conventional boiler plant.

An equally interesting plan came from the Commonwealth Edison-Public Service team working on the problem. Under the law, private ownership of a reactor and its nuclear fuel is effectively prohibited. However, we shall never find out whether or not we can build a nuclear power plant to produce power cheaper than coal, oil or gas until we actually build one. The problem will not be solved by research alone.

Accordingly, says the Commonwealth Edison-Public Service proposal, let us build a nuclear plant now, not in 1970, by these methods.

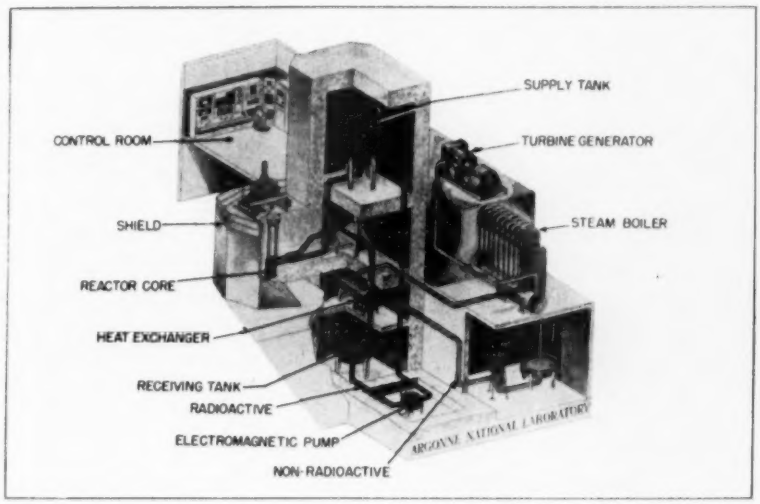


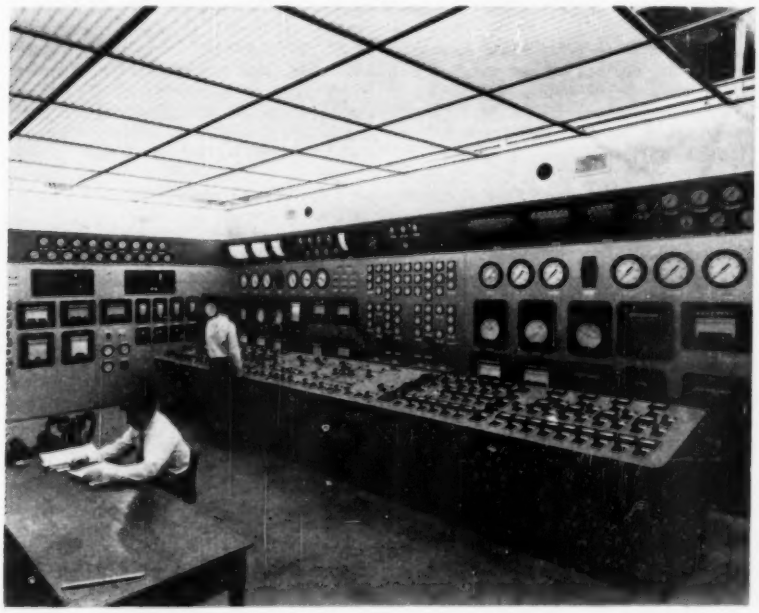
Fig. 12. Section through first atomic power plant, now in operation in Idaho, using experimental breeder reactor, coolant circuits, boiler and turbine generator. Actual plant was described in February issue

Let this utility build a reactor power plant on a site acquired by the utility suitable for a conventional power plant and connected to the general transmission system. The AEC would pay for and own the reactor proper and the nuclear fuel. The utility would pay for and own the conventional turbine generator and auxiliary facilities, switchyard and the like. The reactor would furnish the heat energy to the turbine. If the investment costs of plant were greater than for a conventional plant AEC would make a construction grant. On the other hand, any saving in operating cost below the cost of conventional power would be paid to AEC.

The plan requires no legislative changes at either national or local level. The utility would invest only in conventional facilities, although there would be abnormal problems, but the utility would have some protection. The power plant would produce fissionable material for military use whenever needed and would be a source of income for the government when stockpiling is discontinued. It would be a valuable defense facility; but, besides, the country would benefit from production of plutonium and scientific knowledge while the users of electric utility service would benefit by learning how and how soon nuclear fuel can reduce cost of producing electricity.

Many technical problems remain to be solved. We still have abundant fuel resources. But, on account of the accomplishments briefly outlined above, it looks as though electricity from the atom's nucleus is closer than many people may think.

Fig. 13. Centralized control room in Edge Moor Station, showing recent trend toward locating historical recorders, indicating and operating elements, for operation of the station with a minimum of manpower



New Principles, New Materials—

Tremendous expansion of the electrical industry due in large measure to the continual discovery of new principles and new materials. It is the basic research in principles and materials which makes possible the construction of 250,000-kw generators and 330,000-v transmission systems. Recent development in field of semi-conductors to have profound influence on future course of the industry. Greatest power applications used in research

THIS, like other recent years, has been a big year in terms of electrical development. The industry has forged ahead along many fronts and today we are building larger, more powerful, more versatile, more reliable, and more efficient electrical equipment of all types than has ever been built before. Turbine generators of a quarter of a million kilowatts capacity are under construction, power stations of a million kilowatts of installed capacity are nearing completion and one large operating company is building a 330-kv transmission network. Our installed capacity this year will reach 86 million kilowatts and the total national output will run around 395 billion kilowatt hours.

All these developments are astonishing in the light of what we expected as short a time as a decade ago but perhaps the most amazing aspect of this electrical development is the cost at which the new equipment is being installed. Major steam plants of the highest efficiency are being built today at a cost of $150 per kilowatt compared with $125 in 1947 and $100 in 1940. When these figures are compared with the general construction cost index which today is from 2 to 2½ times what it was 10 or 15 years ago, it is possible to measure in a rough way how well the design engineers have performed their job. No other item in the family budget can equal the record of the cost of electricity. Fig. 1 shows the purchasing value of the householder's dollar from 1939 to 1951.

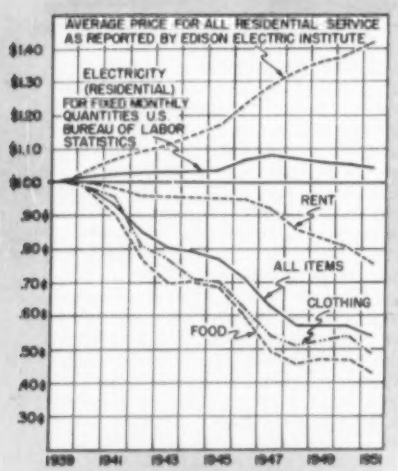


Fig. 1. Purchasing value of the household dollar, 1939 to 1951. (Compiled by Edison Electric Institute)

The trend in electric generation is not only toward larger generating units but also toward larger and larger concentrations of power in stations. Of the almost 50 million kw of installed generating capacity in steam plants at the end of 1951 over 36 million kw was installed in stations of over 100,000 kw capacity.

With respect to generator size it is interesting to note from a report issued recently by the General Electric Co. that the average size of G-E generators made last year was about 70,000 kw. In 1953 the average size will be over 77,000 kw.

At the present time there are at least two turbogenerators on order which will have ratings of 250,000 kw. These machines have been ordered from Westinghouse for TVA. This trend to larger units has good economic justification and hence can be expected to continue. As load concentrations increase, the need for larger blocks of generating capacity grows. Also, the larger the unit, the less the over-all installed cost per kilowatt. The larger the kilowatt rating of the unit, in general, the smaller is the space required per kilowatt.

As the size of generators has increased the voltage of machines also has increased in recent years. For many years, generators in the United States were wound for voltages of 14.4 kv or less. Now, however, in machines of 100,000 kw and above, units of over 14.4 kv have appeared in significant numbers. These have been in the range from 16.5 to 20 kv. There is as yet no dominating trend in this direction and the question of whether a machine shall be wound for a voltage higher than 14.4 kv depends largely upon the number of rated amperes per terminal. A limit of 6000 amperes per bushing has governed most designs up to the present. At 14.4 kv this is the current rating of about a 125,000-kw, 0.85-pf generator. As pointed out by Montieth and Johnson of Westinghouse, it is debatable whether bushings designed for any substantially higher rating will come into general use because higher currents involve serious problems of limiting stray losses within the generator frame and other adjacent magnetic parts. Actually, for the larger ratings, it is better from a design standpoint to use a double winding machine having two full sets of bushings. For the future, considering machines larger than 300,000 kva, double windings with voltages higher than 14.4 will be necessary if bushing currents are limited to 6000 amp.

Excitation Practice

There is also a gradual increase in field voltage of machines as the ratings increase. A field voltage of 250 has been standard for generators with ratings below 100,000 kva though a few machines have had field voltages of 375 v. Most of the machines larger than 100,000 kva, however, have excitation voltages of 375, and it is possible that even higher voltages, perhaps 500 v, will be used. Excitation voltage is not expected to be a limiting factor in the foreseeable future.

For many years, during the time 1800-rpm generating units were in general use, direct connected exciters were almost universal practice. With the development of 3600-rpm machines the direct-connected exciter presented operating problems which could not be overcome in the time available, and so today the largest 3600 rpm generators have either geared exciters or are served by separate motor-driven exciters. These motor-driven exciters have high-torque induction-motor drives which are provided with added inertia. The high inertia aids in maintaining the speed of the sets during system disturbances in which the voltage at the terminals of the motor may be very low or even zero.

The electronic exciter developed several years ago has not had as much acceptance as was expected but with the simplification of the power supply and a good record of performance, it is felt that the use of electronic exciters will increase. Skepticism concerning the reliability and life of the electron tubes used in electronic exciters has probably been a significant factor in retarding their use but this attitude on the part of operators is gradually changing. The electronic exciter meets the require-

Keys to Future Electrical Progress

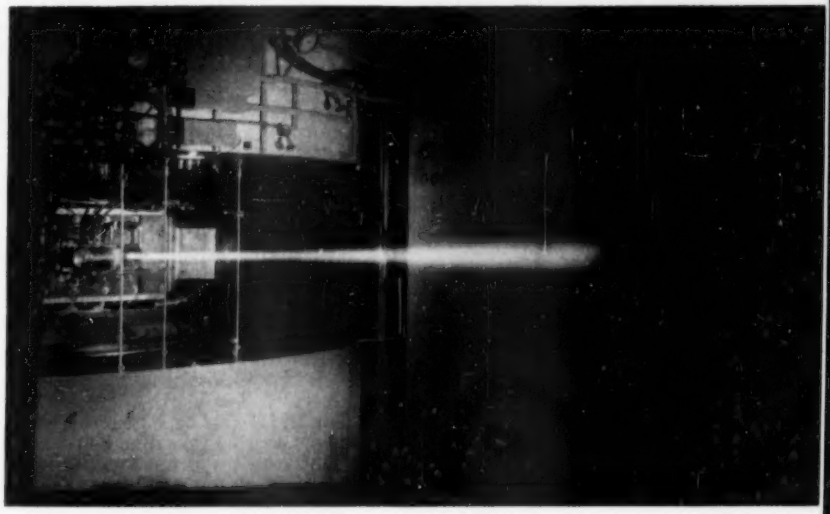


Fig. 2. Beam of deuterons emerging from the acceleration chamber of Argonne National Laboratory's new 60-inch cyclotron. The deuteron beam is visible because of the violet light given off when the deuterons strike the molecules of air. The beam path in air is about 11 ft. This photograph was taken through a 7 ft thick window filled with zinc bromide solution to eliminate radiation hazard.

ments of operators who have had unfavorable experience with rotating machinery using commutators. In some instances the power for electronic exciters has been obtained from a separate small alternator directly connected to the generator shaft. This alternator in turn has been excited by a direct-connected permanent-magnet generator. This method of obtaining the power supply, however, is complicated and expensive. The electronic exciter should be regarded as simply another essential station auxiliary and supplied from the station auxiliary power system.

In the operation of large turbine generators recommended practice involves the preheating of generator fields, particularly those with long rotors. This permits the field winding to expand freely before being clamped in place by the high centrifugal force developed at full operating speed. The expansion of the conductors in the case of some of the long rotors amounts to as much as one inch. Electronic exciters can also be used for field preheating without providing any spare exciter, provided the power supply for the exciter can be obtained from the station auxiliary bus.

During the past few years a number of new turbine generators have been equipped with rotating type amplifiers in the excitation system. These regulators act in the field of the main exciter and eliminate the pilot exciters which have been in more or less common use.

During the year a new high speed regulating system for generator excitation was announced which uses the magnetic amplifier. This system, which was described in the October issue of POWER ENGINEERING, provides very fast response, is extremely reliable, and requires little or no maintenance. Basic elements of the system are the same for any type of synchronous machine, so it can be used with steam turbine generators, water-wheel generators or synchronous condensers. This equipment, consisting of reactors and selenium rectifiers is so rugged that it can be bolted to the end bell of the generator and its life, without any maintenance, is likely to be that of the end bell itself.

The trend toward the increasing use of extremely large generators has brought with it a host of problems all of which have had to be solved in one way or another. The problem of carrying away the losses, for example, has resulted not only in the use of hydrogen for cooling but the use of hollow and specially shaped conductors for windings. When machines were small the natural radiation and convection from the external surfaces was sufficient to keep the units from overheating at normal loads.

Generator Cooling Practice

As the concentration of power in the machines increased, forced air cooling became necessary and later hydrogen cooling came into practice. During the past two years new ideas involving hollow and specially shaped conductors have evolved and future large machines will use conductors of this type for both stator and rotor windings. In this way the coolant is brought directly into contact with the copper in which the heat is generated and the heat does not have to pass through successive layers of coils, insulation, iron and slot wedges to reach the cooling medium.

The insulation problem also has received a great deal of attention. In the early years the voltages were so low that almost any kind of insulation was suitable. Coils were wrapped in untreated cloth and paper. As higher voltages came into use, cloth and paper were treated with natural oils and resins to improve the insulating qualities. Later mica type insulating materials came into use. These involved the use of shellac to bond paper and mica around the conductors but this type of insulation proved to be excessively rigid and brittle for larger units. As the length of generator cores and coils grew, the thermal expansion of the coils necessitated a more flexible insulation. An asphalt bond proved to be quite satisfactory and has been in use by the industry for at least 20 years. In 1950 a synthetic resin-bonded coil insulation called *Thermalastic* was made available which offers increased reliability for large high-voltage generating units. This insulation is based on mica but has an elastic thermosetting synthetic resin for bonding the mica flakes together. The resin forms a solid, well-filled elastic insulation body with the ability of contracting as well as expanding with the iron and copper in the machine during temperature cycles.

330-kv Transmission

Among the important transmission developments of the year was the energizing of the first leg of the new 330-kv transmission network of the American Gas & Electric Company. At present the operating voltage is only 132 kv but late next year the company intends to raise the voltage to 330 kv. This initial line extends a distance of 63 miles from the 600,000-kw Philip Sporn Plant to the 400,000-kw Kanawha River Plant.

This is the first time in this country that a line designed for an operating voltage higher than the 288-kv Boulder-Los Angeles transmission system has gone into service. Later, this 63-mile section will form part of a system of several hundred miles of 330-kv line to be superimposed on the extensive 132-kv network of the AG&E.

An even higher voltage line is being constructed in Canada. This is the 345-kv insulated line of the British Columbia Electric Company. It is to be operated initially at 230 kv. In Europe even higher voltages are being

considered. In Sweden there is already in operation a 380-kv system and a line in France, designed for 400 kv, is now operated as a 2-circuit 220-kv line.

Power Interchange Between France and Britain

An interesting project in the field of electrical transmission is the proposal to link France and Great Britain by means of a submarine power cable so that an interchange of power can be effected between the two nations.

With this submarine connection Britain's steam operated power plants would export energy to France during the summer when drought cuts water supplies for hydroelectric operations. In winter, the electrical tide would be reversed, and French Alpine power would help save British coal.

The first cross-channel pilot link will consist of four lead-covered single-core cables operating at 132 kv with gas pressure to maintain insulation. The British and French power systems are roughly similar in size. In Britain, the capacity available totals 14,200,000 kw from steam generating plants plus 185,000 kw from hydro power.

These recent advances in the art of electrical transmission are the result of many years of highly specialized and intensive study and research in all the underlying factors which govern the design of these lines. Questions concerning line insulation, conductor shapes and sizes, lightning protection, grounding practices, protective relaying, effects of wind and sleet, line maintenance procedure, had to be solved in great number. The problem of system stability, for example, is extremely complex and the larger the system, the more important it becomes. Here, the use of the a-c calculating board has been of inestimable value. First used in 1929, the a-c calculating board has developed at an accelerated rate during the past decade and at present some 40 of them are in use throughout the world. For the most part these boards are used for determining the performance of systems with respect to load flow and steady-state stability. The stability problem also has been solved more recently by the use of the differential analyzer and miniature systems using rotating machine analogues. An example of the latter type of system is the micro-network of Électricité de France. This network with its rotating generator units makes it possible to make rapid and advanced studies of dynamic stability.

A problem resulting from the continual increase in the size and generating capacity of power systems and interconnection of such systems is the protection needed against potential destruction from short circuits and ground faults. At the present time the greatest concentration of power in the United States is in the Northwest power pool, involving Grand Coulee, Bonneville and other hydro and steam plants in that region. It was this concentration of energy that made necessary the installation of circuit breakers with an interrupting capacity of ten million kva. These breakers have the highest interrupting capacity of any breakers in existence at the present time but electrical equipment manufacturers are planning the construction of breakers with even higher interrupting capacities. The newly formed Ohio Electric Corporation involving some 15 operating companies and the construction of new generating stations will bring about a power concentration that may require circuit breakers with interrupting capacities in the neighborhood of 25 million kva. The manufacturers are quite prepared to supply breakers of this rating if they are needed.

The use of circuit breakers with such high interrupting capacities are necessarily expensive but it has been found that this type of protection is more economical than alternative systems using reactors for limiting the short circuit current. These circuit breakers will cost in the neighborhood of $150,000 apiece — quite an outlay for a device whose only function is the making and breaking of circuits.

Looking at the power field as a whole one never ceases to feel astonishment at the long way we have come since the days of Edison, scarcely three quarters of a century ago. When we contemplate the vast network of high-voltage lines stretching from the Atlantic to the Pacific, with its hundreds of great steam and hydroelectric plants, and think of the technical skill involved in keeping it in operation, those of us who have had some part in it can take pride in what engineers have accomplished.

So far, in this article on electrical engineering progress, we have considered primarily those aspects of the field which have to do with power generation and transmission. Now, let us turn to some developments in the use of electricity.

Transistors, Magnetic Amplifiers, etc.

One of the significant, though not generally understood, facts of our highly complex technical civilization is its dependence upon concepts which to most people belong in the realm of fantasy. Atoms, electrons, protons, neutrons and photons have about as much significance to the average person as the Cheshire cat's grin in Alice in Wonderland after the cat had vanished. Yet these shadowy, incomprehensible, entities actually lie at the base of all our electrical and atomic development.

Whatever else it may mean in our lives, atomic energy gives us at last very definite evidence that there is nothing very substantial in the real world. This concept may be of great social importance in the years to come. It will probably take decades, perhaps generations, for a consciousness of the unsubstantial nature of the universe to sink into the minds of people and to influence their social conduct and their spiritual beliefs but, as pointed out recently by W. E. Johnson of General Electric, the fact that all of the substantial matter of the bodies of all the people in New York City could be put into a single cubic inch, and similar information, will, in due course, have its influence on the minds and social consciousness of people.

As these lines are being written, the Atomic Energy Commission has just released an announcement of the explosion of what is implied to be the first thermonuclear type of atomic bomb — the so-called hydrogen bomb. This once again confirms our knowledge of the existence and behavior of protons, neutrons and electrons; somehow, we seem to be able to predict what they will do under given conditions. Therein lies our great power — in the exact knowledge of the properties of these infinitesimally small particles.

The hydrogen bomb provides a spectacular demonstration of the way knowledge of the properties of these minute particles is translated into accomplishment, but there are fields of investigation where knowledge of electrons and other atomic particles is proving equally fruitful even if they attract little attention except among specialists. One of these is the field of transistor development.

The transistor is a device that is relatively new under the sun though perhaps it is older than many of us suspect. History has a way of repeating itself, but always with a difference. Among those who read this, there may be some who are familiar with the history of radio telegraphy, "wireless" it used to be called. They will remember the coherers and the crystal detectors used in the early days. They may seem remote in the

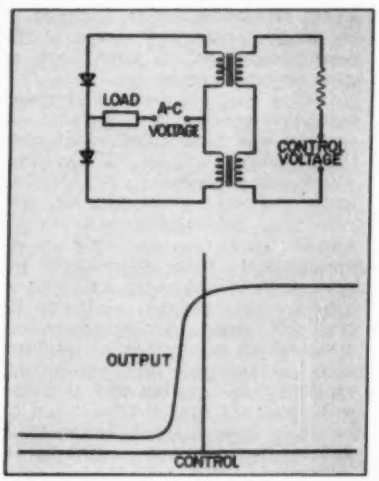


Fig. 3. Showing the electrical connections of two magnetic amplifiers and two selenium rectifiers used in the Magamp. Elements completely sealed.

light of present-day radio development but these coherers and crystal detectors are the primitive ancestors of the semiconductor rectifiers and amplifiers of today. The difference between our use of the early crystal detectors and the transistor developments of today lies in the fact that today we understand what is happening in these semiconducting materials, germanium, silicon, and galena, whereas the early developments were of a cut and try nature.

It is now only a little less than five years since transistors were first announced and when the strange *hole* theory of electric conduction became generally known. True, the hole, or deficit produced by removing an electron from the valence-structure of a crystal, had been prominent in the theory of solids since the work of A. H. Wilson in 1931, but the announcement of the transistor in 1948 gave holes and electrons new technological significance.

The transistor promises to be one of the truly major advances, even in an art which has been accustomed to giant strides. Aside from its primary importance as an extremely useful electrical device it has already greatly extended our knowledge of solid state physics. This in itself is an important result. It may seem strange that the physics of the solid state is a relatively new science but it is nevertheless a fact. Long after the laws of the behavior of gases had been formulated and explained in terms of molecular action, the essential character of the solid state remained a secret. No one could explain how the same molecules could behave so differently in a solid and in a gas.

It was only around the turn of the century when the structure of crystals and the conduction of electricity by metals began to intrigue scientists, that the realm of solid state physics opened up. Crystals had always held a certain fascination for men and the classification of crystals was one of the chief occupations of Arab scientists. To the early observers crystals seemed to be exceptional forms of solids but it is now known that only well developed crystals are exceptional. A very large number of solids, which do not appear to be crystalline at first sight, are seen to be composed of tiny crystals when examined under the microscope. The list includes all rocks and metals.

In 1912 Max von Laue of the University of Munich discovered the method of measuring the position of the atoms in crystals by the use of x-rays. This experiment, one of the most important of all time, laid the foundations for the development of a technique that has proved of immense value and intensified not only the study of crystallography but also the interaction between crystals and electrical forces. In time it was learned that the forces responsible for the formation of atoms and molecules are electrical and this eventually led to a better understanding of electrical conduction in solids. The study of electrical conduction in solids led investigators to class all solids in two general categories, i.e., conductors and non-conductors or insulators. It was known, of course, that there was not a sharp dividing line between conductors and insulators but it was not until relatively recently that serious thought was given to the intermediate class of solids which are now known as semiconductors. It was the study of these semiconductors that led to the development of the transistor.

Basic to the theory of semiconductors is the idea that electrons carry current in two distinguishable and distinctly different ways; one being known as *excess conduction, conduction by excess electrons,* or simply *conduction by electrons* and the other being called *defect conduction* or *conduction by holes.* The possibility that these two processes may be simultaneously and separably active in semiconductors affords a basis for explaining transistor action.

There are two types of transistors of major interest at this time — the point-contact type and the junction type. The point-contact was developed first and has performed at higher frequencies. In many applications, however, the junction transistor promises to be as important as the point-contact type. In comparison with point-contact transistors, the junction types have lower noise, higher power gain, greater efficiency, and higher power handling capabilities. At present, however, they are more limited in frequency response. At first the frequency response of the point-contact transistor seemed to be limited to frequencies in the neighborhood of 4 and 5 megacycles but recently such transistors have been made to oscillate as high as 300 megacycles. The power capabilities of either the point contact or the junction transistors depend largely on the rate at which heat can be removed from the active portion. There are no basic limitations imposed by electronic principles of transistor devices which will prevent the attainment of high powers.

Somewhat allied to transistor development, although based on entirely different principles, is the current rapid development of the magnetic amplifier. The use of the magnetic amplifier in large generator excitation systems has already been described. The reason for relating transistor and magnetic amplifier development lies in the fact that both devices replace the vacuum tube in certain applications.

Despite the recent applications of magnetic amplifiers, these devices are not new; indeed, their development is surprisingly old. References to them are found in the patent literature of 1910, and in 1916 Alexanderson was using them as modulators in his system of wireless telegraphy. Development of the magnetic amplifier, however, was retarded by the advent of the vacuum tube. The high speed of response of electronic equipment opened vast new fields of endeavor for man, especially in the communication field, and this led to rapid development of communication equipment for which there was a vast market. As a consequence little attention was given to the magnetic amplifier and while the electronic industry grew madly, with sales totaling billions of dollars annually, the magnetic industry lay dormant, eking out a bare existence

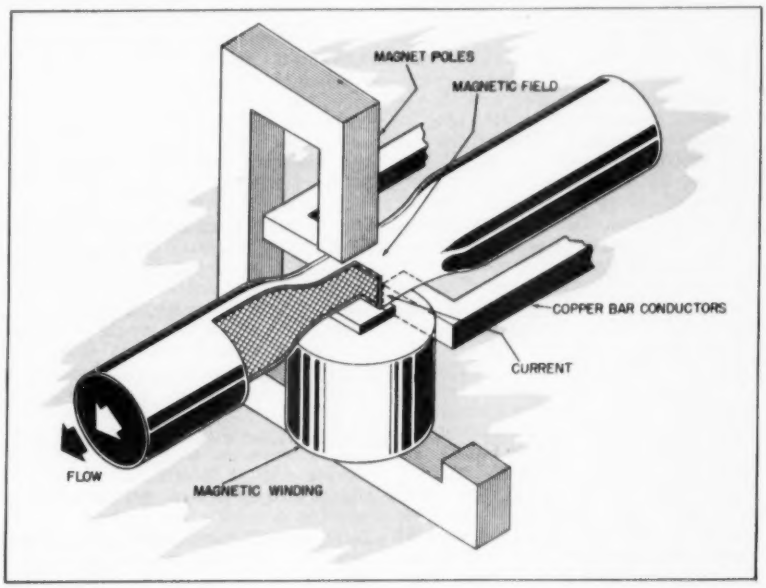


Fig. 4. The electromagnetic pump — something new under the sun, developed for use in liquid metal heat transfer systems in nuclear reactors. This pump works on the principle of the electric motor

dimming theatre lights and acting as filament controls for the large electron tubes.

One reason for the lack of interest in the magnetic amplifier was its slow response. This, it was known, was a consequence of the characteristics of the magnetic material used in the cores. What was needed was a magnetic material with a rectangular hysteresis loop and low core loss.

Before and during the war the Germans had given much attention to magnetic amplifiers and had developed them for various naval applications but these were too slow to be of practical value in modern industrial applications. Starting where the Germans left off, however, on this side of the Atlantic, research programs were begun in 1945 which finally culminated in the development of several magnetic alloys with attractive characteristics for use in magnetic amplifiers. Among the alloys developed was Hypernik V, developed by Westinghouse, and consisting of 50 per cent iron and 50 per cent nickel. This is the material used in the magnetic amplifiers used in the Magamp excitation system developed by Westinghouse. Full advantage of this material's properties are realized by utilizing the essentially gapless, wound-strip, toroidal core construction in the reactors.

The reactors made of this magnetic alloy are vacuum cased in thermosetting plastic, assuring a maximum of environmental protection but at the same time a small, light-weight unit that is mechanically durable and easy to mount. Specially developed selenium rectifiers are used as self saturating rectifiers. Figure 3 shows a diagram of how two of these reactors and two rectifiers are connected in the Magamp circuit, and below it is shown the electrical characteristics. In this type of circuit, the control winding is practically relieved of carrying ampere turns due to the load ampere turns. Only the magnetizing current, determined by the magnetic material, needs to be carried by the control connected windings.

There seems little reason to believe that these magnetic amplifiers and transistors will not greatly affect the future course of electrical engineering development. In the computer field, the transistor will profoundly affect our lives because it will make possible undreamed of developments in automatic control. Already there is in operation at the Massachusetts Institute of Technology a system which combines digital and analogue processes under feedback control to control a milling machine whose cutting tool moves in three planes relative to the work piece. In this case, the model of the object to be fabricated is supplied to the machine in the form of a perforated paper tape similar to that used in teletype systems. The performance of this machine at MIT shows that fully automatic machine tools are not only possible but that they are certain to be developed in practicable form. But such machines will be only the beginning. With digital machines in control we can conceive of factories which will process, assemble and finish any article of manufacture.

One other new development must be mentioned in connection with the development of computing devices. That is the use of ferroelectric materials for storage elements in digital computers and switching systems. Ferroelectric materials are dielectrics in which electric dipoles occur spontaneously and align themselves parallel by mutual interaction. Therefore, the dielectric induction versus applied electric field show hysteresis loops similar to the B-H curves for ferromagnetic materials. A number of dielectric materials such as barium titanate, rochelle salt, and potassium niobate have been found in recent years to have ferroelectric properties.

Specially prepared single crystals of barium titanate, 0.004 to 0.010 inch thick have been used experimentally and while these storage materials are in only the early stages of development, they show considerable promise as a new method for storing digital information in computers and switching systems. They provide a means for storing up to 2500 bits of information per square inch in a surface only a few thousandths of an inch thick. They offer the possibility of low voltage operation, 10 v or less, from transistor circuits, consume no power during the storage period, and provide storage over long periods of time.

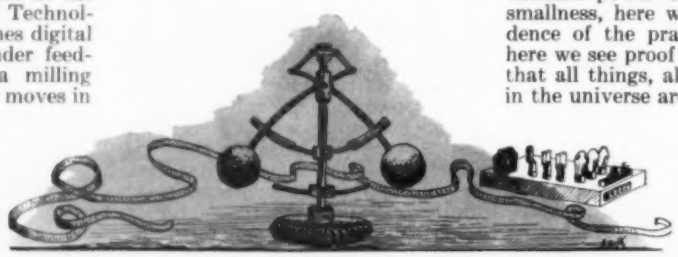
High Power Applications

It is curious, yet perhaps characteristic of the age we live in, that some of the largest applications of electrical energy are for purposes of a purely experimental nature. For example, there is now under construction a single motor which will have a rating of 83,000 hp, and which will be used for driving fans in a wind tunnel for testing aircraft. This will be the largest motor ever built. In addition, this aeronautical laboratory will have several motors rated at 25,000 hp each.

Another example of the use of high power is in the power supply for the University of California Radiation Laboratory's high-energy particle accelerator called bevatron. In this case the power is expended in accelerating the almost infinitesimally small protons and deuterons used in bombarding experiments in nuclear research. When accelerating protons, the energy level is expected to reach 6.5 billion electron volts! The power will be supplied by two motor-generator sets each consisting of a 3600 hp wound rotor motor, a 67 ton solid plate flywheel, and a 46,000 kva, quadruple 3-phase synchronous generator. For a maximum pulse (the energy is delivered at the rate of 11.7 pulses per minute) the stored energy given up by each flywheel during current build-up is about 40,000 kilowatt-seconds. In addition to the motor-generator sets, the installation involves two sets of ignitron converters specially developed for this application and similar in design to the units used in 3000-v railway service.

It seems almost fantastic to think that all this massive equipment and the tremendous forces involved in its operation should be used for nothing more than the acceleration of small particles which we can never even hope to see; yet, when we realize that the entire electrical industry is based on the action and interaction of these small particles, the practice begins to make sense. It is here that all our knowledge begins. Figure 2 is a photograph of a beam of deuterons emerging from the accelerator chamber of the Argonne National Laboratory's new 60-in cyclotron. In the dark, it manifests itself as a beam of violet light, the result of recombination of electrons and ions resulting from the ionizing effect of the high-speed particles on the air molecules. It resembles a beam of sunlight coming through an opening in a dust-filled room but its true nature is vastly different. Things are not what they seem. Actually, this beam of light, photographed through a 7-ft thick window is as deadly as a stream of bullets from a machine gun. And why not? The bullets (the deuterons) in this case are travelling at the rate of 28,000 miles per second.

More than anything else, perhaps, this picture symbolizes the complex technical age we live in. Here we see extreme power coupled to extreme smallness, here we see tangible evidence of the practically intangible, here we see proof of a long held idea that all things, all matter, all forces in the universe are electrical.



Power Engineering's

PRACTICAL ENGINEER and ELECTRICIAN SECTION

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Water Treatment Engineering—
Treatment Adjustments

By L. W. FITZPATRICK
Chief Engineer
Department of Corrections
State of Missouri

The author likens water treatment adjustments to the juggling performed by a new bride in baking her first cake—disastrous results can be expected if control is absent. Here he discusses the factors affecting treatment which require very close control

Equivalents For Water Analysis and Water Treatment

1 Part per Million (ppm)
= 1 milligram per liter
= 1 gram per cubic meter
= 0.05834 grain per U. S. gal.
= 0.00834 lb per 1000 U. S. gal.

1 Pound per 1000 U. S. Gallons
= 120 parts per million
= 120 milligrams per liter
= 120 grams per cubic meter
= 7 grains per U. S. gal.

1 Cubic Foot
= 1728 cubic inches
= 7.48 U. S. gallons
= 28.32 liters
= 0/02832 cubic meter

1 Grain per U. S. Gallon (gpg)
= 17.14 parts per million
= 17.14 milligrams per liter
= 17.14 grams per cubic meter
= 0.143 lb per 1000 U. S. gal.

1 U. S. Gallon
= 231 cubic inches
= 0.1337 cubic foot
= 3.786 liters
= 0.02832 cubic meter

1 Liter
= 0.001 cubic meter
= 61.03 cubic inches
= 0.03532 cubic feet
= 0.2642 U. S. gal.

THE PROVERBIALLY unsuccessful attempt of a new bride in baking her first cake parallels many plant operators in their water treatment adjustments. Although carefully following the recipe from start to finish, both often overlook the essential difference of a satisfactory end result — *control*.

Any water treatment application and/or formula is nothing more than a combination of chemical ingredients (much like the bride's cake mix) designed to stabilize a water so that it remains non-corrosive, does not form adherent scale, and is suitable for the individual thermal process and operation.

However, no basic chemical principle can be used to determine whether or not scale will form. Physical characteristics of the precipitated sludge determine whether it will adhere to boiler surfaces.

Minimum calcium and magnesium scale formation requires internal treatment formulation and adjustment to precipitate these salts in a suitable sludge, and to maintain it in this non-adherent state for removal by manual and continuous blowdown.

Calcium salts are more difficult to control than those of magnesium since the latter readily precipitate with boiler water alkalinity as a magnesium hydroxide floc. Calcium precipitates, which are more dense, do not readily floc.

Once calcium and magnesium salts have been precipitated, organic compounds enter the reaction to maintain this sludge in colloidal suspension. These specific materials have an all-encompassing action, engulfing the precipitate and keeping the entire mass fluid for blowdown removal.

Blowdown depends entirely on the quantity of sludge formed, and the concentration of dissolved solids coupled with boiler water alkalinity. Generally, fluid sludges require less blowdown than dense sludges; hence, the almost universal use of organic compounds in manufactured boiler treatment substances.

Table I. Required Controls for Internal Treatment

Feedwater Hardness	Maximum Ppm
Up to 200 psi	35
Up to 450 psi	20
Up to 900 psi	15
Over 900 psi	7

Alkalinity for Phosphate Reaction

P alkalinity must be greater than ½ M alkalinity. M alkalinity must be at least 200 ppm. This assures a minimum pH of 9.6 in a steaming boiler, equal to 10.5 pH at room temperature.

Table II. Average Controls for Internal Treatment with operating pressures from 300 to over 1500 psi

Condition	Operating Pressure, psi To 300	To 450	To 900	Over 1500
Hardness	0	0	0	0
Phosphate, ppm	30–50	30–50	30–50	30–50
Hydroxides, as $CaCO_3$, ppm	150	130	100	50–75
Total alkalinity, ppm	200	160	120	60–100
Silica, as SiO_2, ppm	150	50	30	10
Total solids, ppm	3500	3000	2000	1300
Suspended solids, ppm	600	500	300	150
Total solids, ABMA	3500	3000	1500	1000

Close Control Needed

Use of both internal and external treatments, regardless of manufacturer, is useless unless close control is maintained by tests, often on-the-hour in many plants. With internal treatments hardness is the regulating factor for the phosphate whether an organic phosphate or organic carbonate is used, because the latter almost invariably contains a percentage of phosphate.

Phosphate control is the simple maintenance of a predetermined quantity of residual phosphate in the boiler drum at all times sufficient to react with hardness entering in makeup water.

With these basic tests for hardness, and phosphate to eliminate possible scale formation, other tests such as alkalinity to phenolphthalein and methyl orange and chlorides complete the general plant procedure. Sufficient alkalinity is required to properly precipitate scale-forming salts. Chlorides can determine overall control of manual and continuous blowdown.

Other tests such as sulfate, sulfite, silica, nitrate, specific conductance, total and dissolved solids can be used; but it is rare that all these tests are required in any one plant for satisfactory water treatment control.

Water Concentration

Limiting the amount of boiler water concentration permissible are the following factors, which can be used as individual indicators of allowable concentration in any particular plant:

For greatest economy, rate of boiler blowdown should be controlled to carry dissolved solids as high as practical without causing difficulties from too high concentrations. Naturally, upper limit of concentration depends on the particular installation and can be determined only after suitable tests.

Initially, concentration should be purposely built up with the boiler loaded and samples of condensed

steam and boiler water taken and tabulated. Concentration of dissolved solids when appreciable carryover first occurs is the upper limit for future water concentrations.

Generally, established ABMA total solids can be safely exceeded with suitable anti-foam additions to a figure about 10 per cent higher than standard. This is, of course, based on adequate sludge removal in properly proportioned boilers and satisfactory alkalinity balances. Any rate of blowdown much over 5 per cent is generally considered excessive by many plant engineers, showing waste, and deficiency in initial softening equipment.

Suspended Solids are often the main factor in boiler water concentration limits because these solids often promote carryover and develop boiler scale.

Alkalinity when in the upper limits promotes foaming. Alkalinity control tests should always be used in conjunction with other blowdown factors since it varies with internal treatment compounds. It is necessary to have a definite upper alkalinity limit beyond which blowdown should commence regardless of any other factor.

The general formula: 2 x (P x Alkalinity) − (M x Alkalinity) should always equal a figure more than 10 and less than 25. Total alkalinity often must be controlled so as not to exceed 20 per cent of total boiler water concentration when solids approach upper ABMA standards.

Silica in high pressure operation is the sole determining factor and blowdown rate must be based on maximum allowable silica content of water. On the basis of silica content it is possible to calculate concentrations of other substances in the water when silica is at maximum range. Experimentation will show a definite relationship of all substances when silica is at a certain range.

Using alkalinity for the control of silica is not practical since alkalinity will not necessarily vary with water concentrations due to the addition of treatment chemicals.

Satisfactory chemical treatment feeding is equally as important as control of chemical balance. In any installation, constant controlled feeding is to be preferred to so called *shot-methods* which often induce undue concentrations of materials in boilers at one time and many times tend to form scales adjacent to the entry into boiler drums.

Proper Boiler Blowdown

Proper use and interpretation of boiler blowdown aids maintenance of good boiler water conditions. Numerous articles have been written about boiler blowdown, but the consensus seems to be that a surface blow is more effective than a bottom blow in removing dissolved and suspended solids from steaming boilers. This is especially important when foaming, priming and carryover occur, in which case a surface blow should always be used.

In modern boilers most solids are in solution and suspension and are readily removed from steaming drums at a low point below normal water level. With this system of operation, lower blowoff valves are opened occasionally to discharge sludge and settled-out materials from lower headers and mud drums.

Continuous blowdown connections should always be made at the end of steam drums where the most water concentration exists. These blowdown connections should never be made adjacent to the feedwater inlet.

Since water carryover in steam is affected by general boiler design and steam space available, position of water level in the drum and rating are important. Constant ratings will give less trouble than variable ones with the possibility of carryover increases under high rating with high water levels.

Continuous blowdown for the same amount of water blown down maintains slightly lower peak concentrations but often somewhat higher average concentrations where steam is carrying away some water due to high moisture content.

Continuous blowdown is especially economical since less equipment is required to recover flash steam and heat since the small quantity of water being continuously blown down is easily controlled. It is a must in larger plants since modern boiler units require holding lower drum concentrations with a greater ratio of blowdown to steam output.

How To Make Field Tests for Condensate pH

These must be done differently from many other water tests, because condensate is unbuffered; its pH may be changed by blowing your breath across it. Here are details of pH tests and precautions, for accurate measurements in the field

By J. B. DAVIS
Water Conditioning Section
Allis-Chalmers Mfg. Co.

Fig. 1. Showing use of universal indicator, one of the several colorimetric methods for checking pH

FIELD TESTS for checking the pH value of water samples usually employ the colorimetric method. Several types of equipment are available for this purpose. The wide range *universal indicator* will provide approximate results. The so-called *slide, block or roulette comparator* is more accurate because individual standards are available for each 0.2 pH unit. In this case, however, ratio of indicator to sample is relatively large. This often results in the pH of the sample being changed by the indicator. In the *water analyzer* procedure, ratio of indicator to sample is relatively small. Hence, effect of the indicator on the pH of the sample is negligible.

For determining approximate pH value of a raw water, boiler water or treated water, either of the first two methods is generally acceptable. Not so, however, in the case of condensate which is highly unbuffered as compared to the other types of waters noted which are buffered solutions.

A buffered solution is one which resists a change in pH value by the addition of acids or alkalies, whereas pH value of an unbuffered solution is readily changed by such additions.

Since pure condensate is a highly unbuffered solution, several precautions must be taken in a field test for determining its pH value. Even with

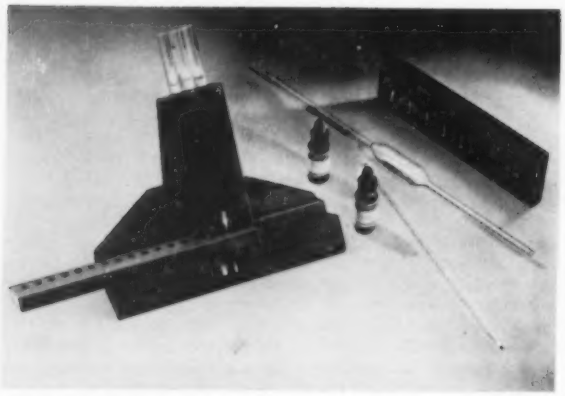


Fig. 2. Shown here is a comparator for making field determination of pH. This procedure will give reliable results with all kinds of waters except condensate

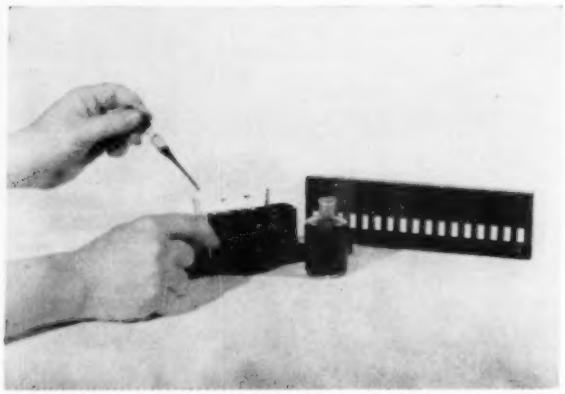


Fig. 3. Use of the slide comparator shows the high ratio of indicator to sample. A condensate tested this way probably will assume the pH of the indicator

greatest care, it is quite difficult to collect a representative sample of condensate and complete a field test for pH without having this value change in some fashion before the test can be completed. In fact, blowing one's breath across the surface of the sample in the bottle is very likely to produce a change. Precautionary measures must include a thorough flushing of the sampling line and rinsing of the container. Then, the container should be filled to overflowing and immediately stoppered.

Sampling Precautions

Determination must be made as promptly as possible after the sample is taken, and readings must be made immediately after sample and indicator have been mixed. Samples to be tested should not be filtered unless it has been proved that filtration does not change pH. Such a change would probably result from exposure to air during filtration or, perhaps, from contact with the paper itself. In any event, if the sample appears to require clarification, settling (in a stoppered container) and subsequent careful decantation (rather than filtration) would be advisable.

Further, it is important that the indicator solution be placed in the tube first and material being tested run in from a pipette, holding the tip of the pipette near the bottom of the tube. This prevents undue exposure of the sample to air. Mixing is best done by stirring either with the tip of the pipette or with a clean glass rod. Mixing should never be done by placing the thumb or the hand over the mouth of the tube since this procedure may introduce carbon dioxide by absorption from the air over the sample and/or add contaminating substances from the skin.

Fig. 4. Water analyzer method has advantage of using a low ratio of indicator to the sample tested

Delivery of a truly representative condensate sample to a laboratory for a pH determination presents some difficulty. It is highly probable that the pH of the highly unbuffered material will be changed in some fashion during transit.

Each of the so-called indicators is either a weak acid or a weak base, and is generally partially neutralized during preparation.

Each indicator shows a definite color change over a specific pH range, which is usually about 1.6 pH units. Beyond these limits there is practically no change in color. For instance, phenol red changes from yellow at a pH of 6.8 to red at a pH of 8.4. If this indicator is added to a material which has a pH of 6.0 it would show a yellow color very similar to that given at 6.8. Similarly, when added to a material with a pH of 9.0, it will show a red color similar to that given at 8.4. The point is that in no case should a color match with the first or the last color standard within any given pH range be taken as an accurate determination. Color match should be as close as possible to the middle of the range.

Comparison of Methods

When using the universal indicator, shown in Fig. 1, it is virtually impossible to secure accurate results on water samples which are not highly buffered. The pH of this indicator must be adjusted to some point which is usually 7.0. Results obtained with this adjusted indicator will be somewhere between 7.0 and the true pH of the sample, depending upon the relative buffer strength of the sample and indicator. Further, most of these long range indicators are in an alcoholic solution and are somewhat difficult to keep in proper adjustment. It is therefore obvious that long range indicators, such as universal indicator, are not to be recommended for accurate determinations and particularly with such highly unbuffered solutions as condensate.

Greater accuracy is secured with colorimetric methods when some type of comparator is used, like that shown in Fig. 2. This procedure is acceptable with all types of water excepting condensate, and here's why.

Remembering the ease with which the pH of a condensate is altered, it will be appreciated that addition of indicator solution can readily affect the pH of the unbuffered material. The extent of such a change is related to the ratio of indicator to sample.

When using comparator methods, 0.5 ml of indicator is added to 5.0 ml of sample — a ratio of 1:10. In this case, the unbuffered solution will assume the pH of the indicator.

Most commercial indicators available are adjusted to their respective pH midpoints. Thus, bromphenol blue indicator solution has a pH of 3.8, whereas bromcresol green is 4.6; chlorphenol red, 6.0; bromthymol blue, 6.8; phenol red, 7.6; cresol red, 8.0; and thymol blue, 8.8.

If the comparator method is used in which the ratio of the indicator to solution is 1:10, the resulting pH will be more nearly that of the indicator than the true pH of the sample. For example, if chlorphenol red (pH of 6.0) is added to pure condensate with a pH of 7.0, the resulting pH will be near 6.0. Similarly, cresol red (pH of 8.0) will give a pH close to 8.0.

One satisfactory way of overcoming this difficulty is to use the water analyzer in which the ratio of indicator to sample is 1:150, see Fig. 4. With this sort of dilution, the unbuffered solution will not have its pH changed by the addition of the relatively small quantity of indicator. If sampling and mixing precautions have been observed, the water analyzer procedure will provide acceptable results on condensate samples.

PREVENTIVE MAINTENANCE . . Cuts Air-Conditioning Costs

A successful air conditioning or refrigeration plant runs efficiently whenever needed. Best way to keep such a plant is with a planned preventive maintenance program

TO ASSURE successful installation of air conditioning systems many owners employ engineers to perfect layout, making certain it is invested with the utmost efficiency — that it has adequate capacity for cooling, moisture control and heating; that air distribution is right; and that air is properly filtered. Elaborate specifications are prepared to make certain refinement of design is incorporated into the plant.

Having successful performance at first is not enough. A plant must continue to function well if it is to warrant the investment. It will do this only with proper care and attention, according to G. H. Walker of the York Corporation in the September issue of *Refrigerating Engineering*.

Maintenance provided by the average owner is haphazard, motivated by occurrence of operating difficulties. Service is called for only when the plant is seriously out of commission or will not run. Such a procedure may seem inexpensive, but in the long run it is not profitable to allow a plant to fail because of lack of attention.

Machinery maintenance can be most successfully applied by intelligent, systematic and regular effort. The following rules will reveal operating troubles when they can be easily and cheaply corrected:

(1) Inspection at regular intervals, regardless of apparent need.

(2) Inspection in a systematic manner with each piece of machinery receiving thorough attention.

(3) Work done by competent personnel, trained to check and analyze performance of equipment.

(4) Adequate supervision to see that work is done faithfully and in accordance with prescribed rules.

Purchased Maintenance

Some large operations can afford employees with ability to operate as well as maintain machinery, but for the average owner there is but one answer — purchased maintenance.

There is a growing trend among refrigeration and air conditioning organizations to offer regular plant maintenance programs, referred to as preventive maintenance, rendered by

Certified Maintenance and Inspection, Oiling and Adjustment (I-A-O) Service for Refrigeration or Air Conditioning

1. Report to the Customer

Obtain any complaints or comments
Obtain outside temperatures

2. Condition of Cooled Spaces

Obtain dry and wet bulb temperatures in cooled spaces (wb—air cond. only)
Check coil condition (bare, light frost, heavy frost) and report to customer
Check condition of insulation and door gaskets

3. Check Entire System for Leaks

Refrigerant Leaks: for I-A-O, repair refrigerant leaks in mains only; for Maintenance, repair all leaks and add refrigerant when necessary
Water Leaks: for I-A-O, tighten connections on water lines only; for Maintenance, repair all leaks
Air leaks on controls (Maintenance only)

4. Strap Thermometers to Evaporator Coil Outlets

5. Oiling and Cleaning

Oil all motor bearings
Clean compressor belts
Clean housings of compressors and motors
Clean motor commutators when required
Clean dirt and lint from air cooled condensers
Clean water cooled condensers internally once a year, if necessary

6. Compressors

Record compressor serial numbers
Check and record suction and discharge pressures
Check high and low pressure switches for proper cut-in and cut-out points
Adjust belt tension (Maintenance only: replace belts when necessary)
Check oil filters and oil pressure gages
Check oil level and oil color in compressor crankcase and add or change oil as necessary
Check capacity reduction control valves
Check automatic starting by-pass valves
Touch up paint when necessary

7. Economizer, Condenser, or Cooling Tower

Record name or model number of equipment inspected
Obtain air or water temperature on and off equipment
Check temperature difference between liquid refrigerant temperature and temperature corresponding to discharge pressure
Purge when necessary
Record pressure after purging
Check water regulating valves (Maintenance only: replace when necessary)
Check circulator operation
Maintenance only: use water treatment if necessary—strengthen if necessary when used
Oil fan and motor bearings
Check and clean fan belts; adjust tension and check drive alignment (Maintenance only: replace belts when necessary)
Check level at overflow for water wastage
Check spray nozzles and clean when necessary (Maintenance only: clean cooling towers)
Maintenance only: clean pans and screens of cooling towers
Touch up paint (Maintenance only: paint economizer or condenser completely when necessary—but not cooling towers)

8. Liquid Controls

Obtain suction superheat at thermal valves
Check and adjust thermal valves as required
Maintenance only: replace when necessary
Check all liquid and suction line strainers and clean if necessary (Maintenance only: replace when necessary)
Check float valves and adjust as required

9. Air Units and Dehumidifiers

Oil all fan bearings
Check and clean belts (Maintenance only: replace when necessary)
Adjust belt tension and check drive alignment
Check all damper positions and oil the damper bearings
Check spray nozzles (Maintenance only: clean if necessary)
Check dehumidification overflow for chilled water wastage
Maintenance only: clean finned coils
Check strainers and clean if necessary
Inspect air filters
Maintenance only: clean or replace filters if necessary
Touch up paint when necessary (Maintenance only: paint completely when necessary)

10. Inspect Piping, Insulation, and Painting and Record Condition

11. Recheck Condition of Cooled Spaces

Record room temperatures
Adjust air distribution if necessary
Adjust controls if necessary
Record outside temperatures

12. Report to the Customer

Conditions being maintained and inspection completed (I-A-O only: repair work which should be done)

trained personnel working exclusively in customer plants.

Preventive maintenance does not mean periodic inspections at the owner's discretion. It means a contract has been written wherein, for a specified time, the contractor will send a man to make a complete plant inspection at regular intervals (usually monthly).

One such form of preventive maintenance covers inspection, oiling and adjustment of machinery; any required repairs found are reported and attended to on a time and material basis. This contract is called an I-A-O agreement by York Corp.

In another type contract, the contractor agrees to inspect, oil and adjust the machinery and, also, to supply repair parts, refrigerant, oil and other materials needed to keep the plant in perfect working condition. York calls it a Certified Maintenance contract. It is really a form of insurance. The owner pays two bills: for power and the monthly charge for certified maintenance.

The table shows the summarized procedure used as a guide by the inspector. His findings, good or bad, and corrective action, are recorded on a special report form.

Most of the items may seem of obvious nature, but their significance lies in the advantages to the owner of the plant serviced. Preventive maintenance advantages are: saving in operating cost (power and water bills, etc); business protection; maintenance savings; insurance of original investment; convenience.

Some Inefficiencies

Every refrigerating machine has a mechanism to control flow of liquid refrigerant to the cooling coil where it is evaporated. This may be an automatic thermally-controlled expansion valve, or a float valve. Both types possess small orifices easily clogged by dirt; and plant efficiency is very sensitive to expansion valve performance. A restricted flow of refrigerant causes cooling coils to become starved, lowering balance suction pressure below design point. More power input to the compressor is required to produce a ton of refrigeration as this pressure is lowered. It is, therefore, advantageous to cool at as high an evaporative pressure as possible. This can only be done while expansion valves are functioning properly.

A clogged or partially clogged strainer on the liquid refrigerant line ahead of the expansion valve or at the compressor can cause this also.

A Freon system with refrigerant charge contaminated with water can be the source of elusive operating disorders. Water, as it passes through the expansion valve, freezes, clogging the small orifice and starving the evaporator. Other times, ice holds the valve open and causes overfeeding of the evaporator.

An expansion valve allowing too great a refrigerant flow to the evaporator also causes trouble because liquid refrigerant leaves the cooling coils with spent gas traveling back to the compressor. Normal compressors can handle a small quantity of such free liquid, but it interferes with normal lubrication of cylinder walls, is prone to break suction and discharge valves, materially reduces capacity of the compressor to pump gas. As power input is not concurrently reduced, cost per ton of refrigeration is increased.

It is more economical to operate with as low a condensing pressure as possible with temperature level imposed by the medium used to supply condenser cooling.

A clean condenser with adequate water or, if an evaporative condenser, adequate air will give desired low condensing pressure. But let the heat exchange surface become fouled with dirt or scale and head pressure starts jumping. So does the power bill, and sometimes the water bill.

Chemical Control

One feature of preventive maintenance is chemical control given to condensing water. Water is periodically tested and treatment applied when needed to eliminate precipitation of solids on condenser tubes and keep algae formation low.

Contamination of refrigerant charge by so-called noncondensable gases must be watched. These gases usually consist of air or oil vapors and collect in the condenser gas space. They increase head pressure above normal condensing pressure by the fraction of partial pressure they exert. Any increase of head pressure uses more power.

A fouled makeup water float can result in expensive loss of city water in a month; or, if the valve is stuck shut, the condensing system soon loses water and the plant is automatically shut down from excessively high pressure.

Freon refrigerants are virtually odorless, and leaks can go unnoticed until the plant fails. The leak must then be repaired and refrigerant replaced at great expense.

It is the function of a preventive maintenance engineer to catch these difficulties and correct them while they are still in embryonic stage.

For example, filters are installed in an air conditioning system to purify air as well as to keep out dirt and dust. Filters save cleaning expense and make interior redecoration a less frequent occurrence. Filters need systematic servicing provided by preventive maintenance, for they are first to show failure from lack of attention. When the filter bank gets dirty, it retards air flow and interferes with functioning of the air conditioner. If plates of an electrostatic filter get too heavily loaded, filtering action is stopped or retarded and sometimes accumulated dirt blows into the fresh air stream.

It is the duty of a building engineer to operate refrigeration and air conditioning equipment. However, many owners have found it advisable to relieve him of the responsibility of maintaining this equipment by purchasing preventive maintenance. Too often building engineers do not have time to give their systems the regular care imperative to successful operation. In addition, the necessity of adding another engineer is avoided at a saving.

The Building Engineer

Many building engineers will frankly admit lack of experience in maintaining such equipment. They realize specialized skill is required to do the job well. This is where preventive maintenance can be valuable.

There is another circumstance frequently encountered. It is installation in a building of marginal size. Addition of air conditioning adds sufficient burden to the mechanical maintenance to require services of an engineer. A maintenance contract is often the answer to economically sound installation and operation of such equipment in buildings of this type.

Preventive maintenance regardless of the circumstances costs less than haphazard repair service. Comparisons, however, must be made over an extended period to allow time for development of natural deterioration that always occurs when maintenance problems are attended to at random.

One serious breakdown, such as the complete loss of refrigerant charge, in many cases costs enough to pay for preventive maintenance for a year or more. Likewise a condenser or compressor failure can be very expensive, in addition to putting the plant out of commission.

The American Society of Heating and Ventilating Engineers' *Guide* suggests that compression equipment of an air conditioning installation can be written off in 10 years, and that centrifugal equipment can be written off in 15 years.

If by proper care and attention the plant could be assured of lasting, say, 5 years more than expected, the extended utility of the initial investment would more than pay for the expense of maintenance throughout its life.

Comparison of Plans

The advantage of the Certified Maintenance plan previously described over the inspection type (I-A-O) is most pronounced when considering maintenance costs over the entire span of the useful life of the equipment. The total maintenance plan guarantees the owner that he will have an operating plant for as long as he has need for it, or until it is discarded or replaced due to obsolescence.

Another appealing aspect is the regular monthly payment which assists in financial planning. Excessive repairs that might require special financial arrangements are precluded.

Small Aftercooler— Homemade and Effective

By H. B. McDERMID

Moisture in a compressed air system demanded use of an aftercooler, but suppliers couldn't fit space conditions. A homemade unit finally did the trick

A LARGE WOODWORKING company with no compressed air system relied upon its exhaust system to clean equipment. However, this did not keep machines at the standard of cleanliness the maintenance supervisor deemed desirable. He believed a clean machine was important to careful inspection and consequent detection of small troubles before they grew into serious ones resulting in lost production and extensive repairs.

He finally persuaded management to purchase a 300-ft air compressor. After careful placement of the machine to have the air intake pipe in the most favorable location, he found that on rainy or damp days so much moisture was sucked into the system that many complaints of spoilage of fine millwork came from operators using the system.

The situation was so serious that he had to get results fast and economically. He first canvassed suppliers for an aftercooler to fit his job conditions. He found that the most suitable one would have to be installed along a wall, being nearly 18 ft long. It also required at least that much more free space in which to pull internal pipe coils for cleaning, according to the manufacturer.

He had no such space in his engine room, the only place for the apparatus; so he began figuring on a homemade one to meet the requirements. He finally devised an aftercooler which was only 30-in. square and 30-in. high. It was cheaply made in his own shop by mechanics — and did the work perfectly.

He first welded up a tank 30-in. on each side; and, keeping simplicity of fabrication and common sense operation uppermost, he placed two headers of 4-in. pipe in one end of tank, top and bottom. Both ends of the pipes were welded shut with flat plates, adequate in strength, but saving tank space compared to stock pipe fittings. Each header was drilled to accept the ends of 3- to 4-in. copper pipe coils. Copper, then in stock, was bent to proper form after annealing. Copper was selected because of its high heat conductivity and ductility, holding over-all dimensions to a reasonable limit and still keeping the unit simple. Figures 1 and 2 show details of the aftercooler.

The air intake pipe came in at the top of the top header in one corner of the tank, and the discharge air pipe came off the top of the bottom header at the opposite corner. All air was forced to travel the full length of the condenser surfaces, providing maximum cooling effect. Condensate traveled in the same direction as air and drained out the bottom of the same header. To prevent condensate from being sucked into the outgoing stream of air, baffle plates were welded into the header.

Water inlet and water outlet, placed at diagonally opposite corners, allowed the cooling element to travel a good distance over the coils before flowing to the boiler makeup well for further use. Water intake could be connected more efficiently to the bottom of the tank at the same corner, the water thus being forced to travel the vertical diagonal as well as the horizontal diagonal of the tank. However, in operation, the outgoing air pipe was found to be very noticeably cold, while the incoming line was blistering — a marked temperature difference.

When put in service with 50 F well water as a cooling agent, the device proved effective by taking out all entrained water and oil, leaving only clean, dry air for use on the fine millwork and ended the operators complaints. This homemade aftercooler stayed on the job for several years without any upkeep costs.

Fig. 1. Plan of the home made aftercooler showing the location of air and water inlets and outlets, and arrangement of headers and cooling coils

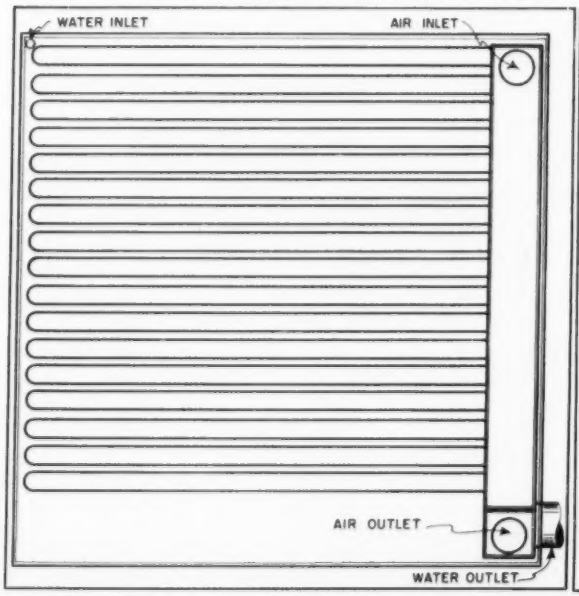
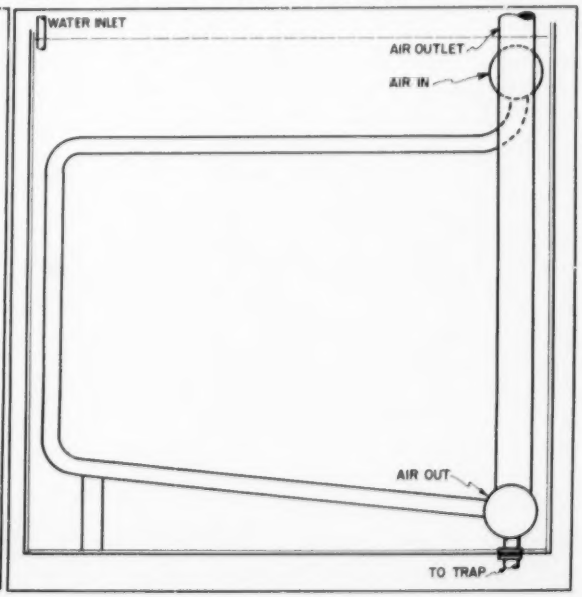


Fig. 2. Side view of aftercooler with the side sheet removed showing coil shape. Well water was used as the cooling agent with excellent results



Steam Turbines Boost Paper Output 12%

At the Northwest Paper Company, Cloquet, Minn., two new steam turbines drive paper machines at increased speed, raise production and quality

INSTALLATION of two steam turbines to drive paper machines at the Northwest Paper Co. mill at Cloquet, Minn., Fig. 1, has increased production of the machines 12 to 13 per cent, opened the way to much larger production gains in the future, and effected improvements in paper quality. Still another benefit has been reduction in such operating costs as superintendence and maintenance of power equipment.

With demand high for its quality line of printing, envelope and converting papers, the company has sought constantly to increase productivity of its equipment while maintaining high quality. Cloquet is an integrated mill producing 275 net tons of printing paper a day. The mill neither buys nor sells pulp, producing 175 tons of alkaline pulp and 100 tons of sulfite pulp a day with its own facilities.

To achieve this production, it was necessary to expand output of the paper machines. Analysis of the problem by E. C. Gamble, manager of the Mechanical Service Dept., showed that No. 1 and 2 machines were limited by drying capacity. No. 3 and 4 machines had reserve drying capacity and were limited only by speed. It was concluded that the easiest way to get an immediate production increase was to raise the speed of No. 3 and 4.

No. 3 machine, with Fourdrinier wire 96-in. wide, was driven through a line shaft by a reciprocating steam engine at a maximum speed of 530 fpm (feet per minute). Limiting factor was rim speed on the line shaft pulley. If the pulley were changed, the engine could not control speed closely. Solution was the installation in July, 1951, of a 300-hp steam turbine, shown in Fig. 2. Rated at 5050 rpm, this unit drives the line shaft through reduction gears which reduce output speed to 550 rpm. With the new turbine, it was possible to run the paper machine at 600 fpm, a gain of 13 per cent. The turbine can support much higher speeds, and alterations are being made in the paper machine to permit quality output at 1000 fpm. This will mean a gain of 88 per cent over original speed.

No. 4 machine, with 212-in. Fourdrinier width and 197-in. trim size, was driven by a 415-hp turbine. With this turbine at maximum power and speed, paper-machine speed was 830 fpm. In July, 1951, a 700-hp steam turbine was installed which turns at 4750 rpm and drives the line shaft through reduction gears at 550 rpm. The new turbine, Fig. 3, immediately raised machine speed to 930 fpm, a 12 per cent rise. Actually, the turbine is designed to permit 1200 fpm production but speed is limited now by capacity of back line belts. Contemplated change in back line gears will allow maximum speed without exceeding proper belt speed. Expected 1200 fpm will be a 44 per cent increase over original speed.

Production speed is a major consideration, but Northwest is equally concerned with paper quality. Particularly in the case of offset printing paper, uniform weight is essential and this, in turn, necessitates close control of machine speed. With the old engine, it was necessary to have a man stationed near the engine to handle speed changes on signal from the floor above. Now, turbine speed is controlled from a pushbutton near the paper machine, permitting the operator to control paper weight by instant, smooth speed changes to compensate for temperature and other factors. A wider range of speed variations is also possible.

The operator wants instant, accurate speed change when he calls for it, but generally he wants steady, unvarying speed. Governing has been excellent and new units have entirely eliminated off-weight paper caused by speed variation. The company keeps a spare governor on hand and can switch governors in half an hour. There has never yet been need for such replacement but it is felt that the spare represents real protection against costly shutdown.

The new turbines were installed between 6 a.m. Sunday and noon Monday with a loss of only four pro-

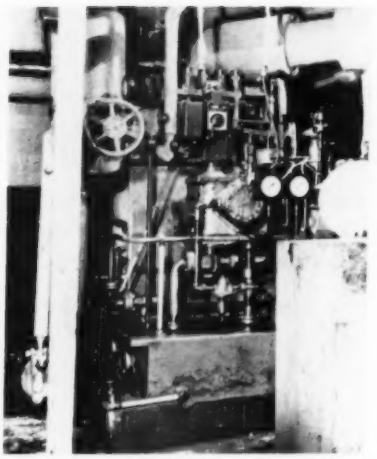
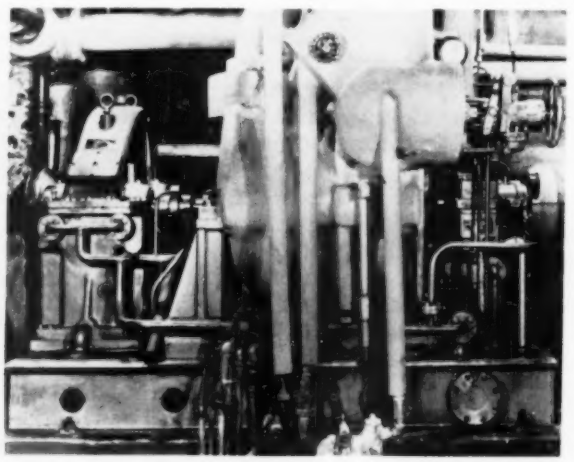


Fig. 3. View of 700-hp turbine shows multi-valve system which automatically regulates inlet steam

Fig. 1. Northwest Paper Co.'s plant at Cloquet, Minn., increased production while maintaining quality by installing turbines to drive paper machines

Fig. 2. This new 300-hp turbine drives a large paper machine at 550 rpm through a line and shaft belting. Exhaust steam is used for drying operations



duction hours. Currently, the plant runs 24 hr a day, 7 days a week, and savings in maintenance time have been far greater than time lost on installation. With the reciprocating engine, it had been necessary to tighten quarter and hind-shaft blocks, clean out carbon, take up bearings, and perform other maintenance once a week. On the new turbines only a yearly inspection is planned. To date there has been no maintenance work at all on the turbines since they went into regular service.

Costs of lubrication also have been reduced. Long-life turbine oil of a detergent type is used and is cleaned in an activated clay filter.

System Operation

The multi-stage turbines were integrated with the existing steam system which includes 4 water-tube boilers with continuous rating of 300,000 lb of steam per hr, and two turbine generators, one rated 1500 kw and the other at 2500 kw. Company's total electric requirements are about 10,000 kw, part of which is supplied by a hydro plant with 5000-kw maximum capacity and 2000-kw firm capacity. Part of the load is handled by a private utility and the rest is produced by steam turbines. Turbine generators are used only as much as is necessary to provide process steam for the mill.

Average inlet temperature for the new geared-drive turbines is 190 psig at 100 F superheat. Multi-valve system on the turbines has been an aid to operating efficiency since it automatically shuts valves when load drops, providing better speed control and economy. Exhaust pressure is varied from atmospheric to 50 lb in accordance with drying requirements.

Since all steam is used for processing, a multi-pressure system is planned for the plant with a dispatcher to send steam to various machines in accordance with drying requirements. It will be possible to set up pressure and temperature to suit specific paper on machines and thus promote quality.

Use of steam in drying was another factor in the decision to replace the reciprocating engine with a turbine. Previously some oil in steam exhaust had tended to degrade drying efficiency. With installation of the new turbines oil contamination of steam has been eliminated.

Principal Equipment Serving Turbines

Turbines	One 300-hp, 175 lb, 525 F, 5050 rpm, Type S-2. One 700-hp, 175 lb, 525 F, 4570 rpm, Type S-4. Worthington Corp.
Reduction gears	Worthington Corp.
Governors	Woodward Governor Co.
Oil cooler	Kewanee-Ross Corp.
Gages	Crosby
Tachometer	Brown Instrument Co.
Pressure recorder	Bristol Co.
Steam flow recorder	Bailey Meter Co.

Handy Trouble Lights for Maintenance Men

By F. E. RILEY

MAINTENANCE MEN and erectors of heavy machinery often have to work in dark locations which call for temporary lighting of some kind. One form of light consists of a wooden handle to which is attached a wire frame enclosing the light bulb, as shown in Fig. 1. This form of light is fitted with a long flexible cord and can be hung on any convenient projection by means of a leather loop fixed to the handle, or it may be carried in the hand so that light is shed upon the working area.

This lamp is fairly efficient for its purpose but if it is used for very long, the glare thrown out from the unshaded bulb causes eyestrain, impaired vision of the work and fatigue.

Fig. 1. Trouble light with aluminum painted bulb

An efficient way of shading the bulb is to paint the glass exterior with heat-resisting aluminum paint. Several coats of this will be opaque to light and since the paint has reflecting properties, maximum illumination from the lamp filament will pass through the unpainted portion of the glass.

Parts of the bulb covered by paint can be arranged to suit the requirements of individual users. For instance, half the bulb circumference may be shaded by painting so that the light will shine out horizontally when the hand lamp is stood on the ground or hung vertically. An alternative method of shading is shown in Fig. 1. In this instance, the whole of the bulb exterior has been painted, with the exception of the bulb end. The effect is self-evident from the photograph. When the lamp is hung vertically, the light shines downward upon a horizontal working surface. When held in the hand, the lamp works in a manner similar to a flashlight — directing light where the lamp is pointed.

This idea has proved very efficient in practice and contributes greatly to comfort and more efficient visibility.

Portable electric drills are now available for use in one hand but even the smallest can be worked more efficiently if the user can work with both hands, instead of directing a light on the work with one hand and operating the drill with the other. Often, in maintenance and erection work, the operator needs a free hand in order to support himself. If he is holding a light in one hand and a drill in the other, the risk of accident due to falls is greatly increased.

A method of lighting the area to be drilled is illustrated in Fig. 2. Here, both light source and drill have been converted into one integral unit by securing an ordinary flashlight to the body of the portable drill by means of metal clips. Both drill and light can be used with one hand and light is always shining upon the area to be drilled.

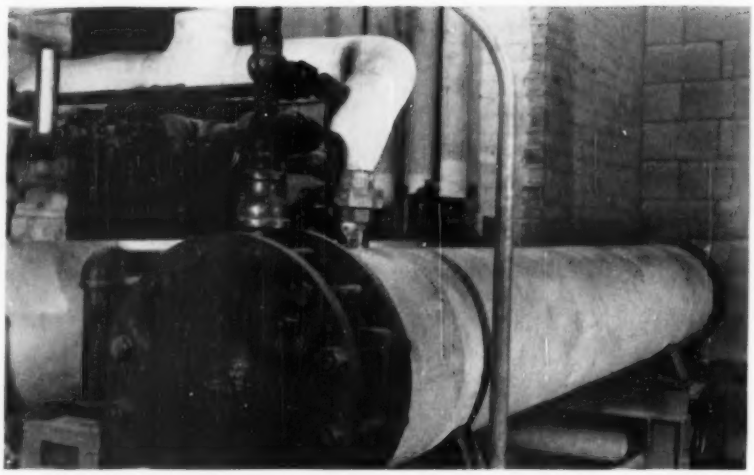
The metal clips illustrated are made from $\frac{1}{32}$ by $\frac{3}{8}$ in. soft steel strip held together with small nuts and bolts. Clip shapes will vary according to the shape of the drill body. Naturally, the light is intended for intermittent use only, in order that the battery life be conserved but no trouble has been experienced on this account in the case of the drill shown. It has drilled thousands of holes in dark situations on one pair of cells. No trouble has been experienced through vibration damaging the flashlight bulb.

Fig. 2. A flashlight mounted on a portable drill

Molded-type Insulation on Heat Exchanger

BY APPLYING molded-type pipe insulation on a 120 F heat exchanger, a Chicago contractor provided the Union Special Machine Company with an efficient insulating jacket that is low in cost while installed easily and rapidly for many years of trouble-free service. Standard 1½-in.-thick molded-type mineral wool fiber pipe insulation in two sections was wired in place with 18-gage galvanized iron wire at about 18-in. centers along the 10-in. shell.

Because the standard length of the molded-type pipe sections is 36-in., only three units of insulation were required to cover the 9-ft-long exchanger. The mineral fiber insulation was finished with 4-oz canvas pasted over the surface, sizing the paint.



Note how the insulation has been cleanly cut to fit closely around the supports and the connecting lines

Surface Condenser Heats Mill Water

By ALBERT H. MOULTON

IN ORDINARY condensing practice, the latent heat in steam exhausted to the condenser is lost, but here is a case where it was all recovered. The condensing turbine in a textile mill exhausted to a surface condenser, using clean lake water which could be used for washing and other processes. It was discharged to a hotwell, supplied with low pressure steam to bring it up to the required temperature when needed. Condensed steam was pumped back to the feedwater heater and used for boiler feed. From the hotwell the heated water was pumped to mill supply. At times of light electrical load, the turbine could be run under lower vacuum, giving higher hotwell temperatures.

Perhaps the savings effected by this arrangement would be of interest. Operating conditions: Kw load 500; steam pressure at throttle, 140 psig; superheat, 50 F; total heat, 1223 Btu per lb; exhaust 3 in. Hg; efficiency of turbine 60 per cent; available heat in steam, 300 Btu per lb; heat utilized by turbine, 180 Btu per lb; heat rate, 19 lb per kwh; heat rejected to condenser, 1043 Btu per lb steam.

Total heat rejected to condenser per hour =

$$500 \times 19 \times 1043 = 9{,}908{,}500 \text{ Btu}$$

This would heat 19,872 gal of water from 60 to 120 F and, allowing 9000 Btu as the heat in a pound of coal utilized by the average boiler plant, is equivalent to 1100 lb of coal per hour, or 13.2 tons of coal in 24 hours.

Whenever we use the latent heat in exhaust steam for building heating or process work we are getting out about all there is in it — and that is efficiency.

Plastic Conduit Goes Underground

IN A TEST PROJECT undertaken by Kingsport Utilities, Kingsport, Tenn., in cooperation with Tennessee Eastman Company, a trial installation has been made in a Kingsport city block using extruded Tenite plastic pipe for the first time as underground conduit for power lines.

The plastic piping was selected for test conduits because of its successful use in the oil fields and other industries, which pointed up its flexibility, ease of installation, corrosion resistance, high impact strength and light weight.

When installation work began, the operator of the mechanical ditch digger had only to scoop up clay and shale rock. Exact straight-edges and base required for the usual rigid type of conduit was not necessary.

Joining was a speedy job, too. All that was necessary was to brush on some thinner to soften the section ends, follow with Tenite II cement, and slip together. After drying for 30 minutes, the joint was as strong as the pipe itself.

One man can lift and carry six 20-ft lengths of the 2-in. plastic pipe used in the conduit test installation

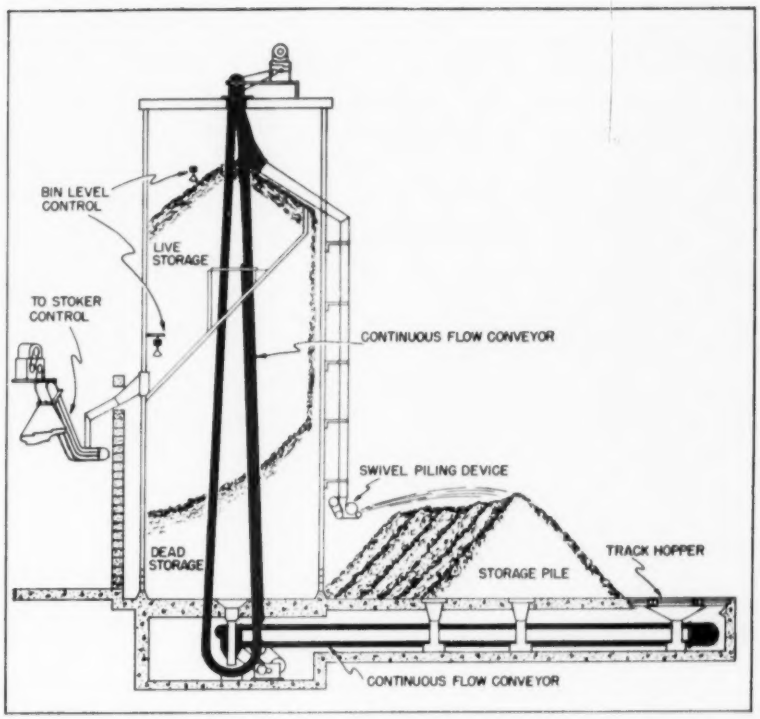
Coal Handling System Helps Cut Power Costs

MODERN COAL HANDLING and automatic controls have brought about power production savings of $90,000 a year at the Kerr Bleaching and Finishing Works in Concord, N. C. A single boiler replaces 9 units formerly required, and at the same time fuel manpower requirements have been drastically cut, according to the *S-A Conveyor*.

In addition to contributing to this remarkable efficiency record, the coal handling system provides dustless transfer from silo storage to boilers plus unique delivery to yard storage.

The 25-ton per hr conveyor system, shown in the drawing, consists of a 9-in. tunnel continuous-flow conveyor running 76 ft from a track hopper to a double-leg, continuous-flow elevator inside a tile storage silo. Coal is lifted 84 ft before being discharged to a live storage shelf.

After overflow from live storage fills the remaining silo space, a swivel piling device builds up yard storage on a radial pile. The device throws coal 60 ft by means of a short, high-speed belt. Idler discs cause the belt to run in a concave path so that centrifugal force hugs coal tightly to the belt, enabling it to pick up speed quickly.



Tile storage silo is fed by a 25-ton pr hr conveyor system. Note swivel piling device for yard storage

From live storage coal is delivered to the boiler by a 9-in. horizontal-inclined continuous flow conveyor. A new boiler now being installed will be fed by a loop boot, inclined-horizontal unit.

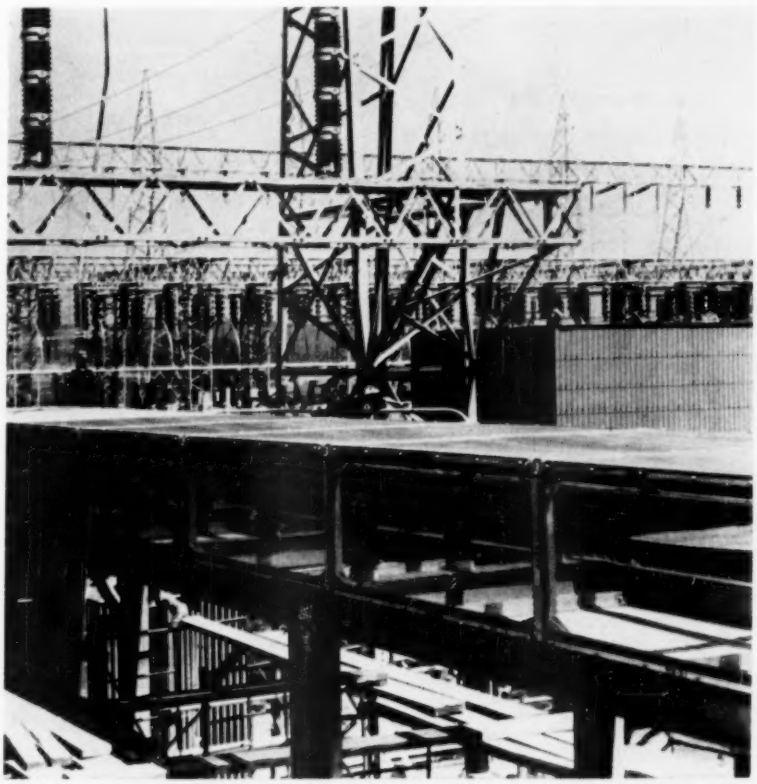
Expanded Aluminum for Bus Bar Guards

HANGING HIGH TENSION electrical bus bars many feet above ground is not enough to isolate them from trouble. Birds and flying debris are constant hazards. In large generating plants, a bird lighting among the buses may disappear with a burst of flame and a noise like a cannon shot. This is tragic for the bird — and not too good for the electrical system. Short circuits of this type can cause interruptions in power supply, and may even damage generating equipment.

Engineers of the Tennessee Valley Authority solved this problem with aluminum expanded metal. Using this material, engineers designed a light-weight, non-corrosive housing for outdoor bus bars in TVA generating stations. A structural frame, also of aluminum, supports the $\frac{1}{2}$-in., 0.081 standard expanded aluminum sheets.

New housings add a minimum load to main supports for bus bars. The expanded aluminum weighs less than the solid sheet and offers little wind resistance.

A further benefit claimed for the expanded metal is its lower cost in comparison with a sheet of equal area. The expanded form is actually stiffer than the sheet.



How TVA engineers cover hot bus bars in their plants with screens to isolate them from birds and debris

Questions and Answers

Your fellow engineers will answer your power engineering questions. You answer theirs, get paid well. Simple? Effective? Why don't try it?

Question No. 504

What Changes Are Needed to Drop Heating Steam from 125 psi to 15 psi?

I HAVE A PROBLEM in changing my heating plant from a 125-psi high-pressure plant to a 15-psi low-pressure plant. I am now operating with two 150-hp, type XL, Titusville return tubular boilers equipped with two 3½-in. safety valves and one 6-in. non-return outlet valve on each boiler, which is also equipped with a Riley stoker. I do not have any flow meters, draft gages or CO_2 meters to indicate whether I am now operating at full capacity.

Two-thirds of the heating system, which averages about 5 lb steam pressure on the steam risers, has gravity returns and one-third has vacuum returns.

Therefore, my problem is: what changes are necessary on the boilers, in regard to the safety valves and the outlet valves, and will a vacuum system be necessary on the two-thirds of the heating system that is now gravity?

Buffalo, N. Y. L. W.

Answer No. 497

What Can He Do About This Hotwell Pump?

Solution From India

IT IS UNFORTUNATE that M. P.'s circumstances do not permit him to lower the hotwell, or to raise the pump. This is one of the trickiest pump problems — NPSH. One solution is to use a larger (dimension, not capacity) pump requiring lower NPSH, or two pumps in parallel; but, if space permits, probably a cheaper solution would be to use jets as boosters. Any cavitation that may occur will be in the jet where replacement costs will be lower than for the pump. Use of a specially designed pump can also be considered but efficiency, capital and maintenance costs are unfavorable.

M. P. seems to be getting pumping trouble only when level in the hotwell goes down to a certain limit. Can he not sacrifice some net available storage capacity of the hotwell and control level in the well? Pump delivery can then be fitted with an automatic valve taking its impulse from tank level. Alternatively, tank level can be controlled very simply by providing a bypass from the pump back to tank, with the common float-valve arrangement. The new available storage, if found insufficient, can be increased by increasing tank dimensions in any direction.

Mithapur, India J. D. ADHIA

Answer No. 501

Why Do These Steam Flows Differ by 20%?

Check Meter Operating Conditions

I WOULD SUGGEST that M. J. H. check operating conditions at each meter, even though his letter insinuates this has been done.

Nearly all steam flowmeters measure pressure drop across an orifice. Relationship is the very familiar one of $V = \sqrt{2gh}$. When the area of the orifice (A) is known, then we have the familiar formula $Q = AV$, where Q is volume per unit of time.

All steam flowmeters are essentially volume meters, although they are calibrated on a weight basis. This is done by designating the meter to function at some steam condition and dividing the volume rate by the specific volume of the steam at that condition. If the actual specific volume is smaller than that for which the meter is calibrated, the meter will read low.

If M. J. H. will install pressure gages and thermometers (only if steam is superheated) at each meter, he can determine a correction factor for each meter which is simply a ratio of the specific volume of the steam at the calibrated condition to the specific volume at the measured condition.

Ithaca, N. Y. E. S. MONROE

Determine Steam Quality

MAKING TOTALS of five boiler meters come out even, or near even, to five meters on supply lines is pretty hard to do, even if there were no losses in pipe lines due to condensation. M. J. H. does not say what initial steam conditions are — superheated, saturated or wet, but assumes about 5 per cent condensation.

Steam meters do not take into account quality and pressure of steam, but merely record differential pressure across the orifice. It might be well to check them at the boilers and also at the take-offs from mains by tapping in gages and connections for calorimeters to determine steam quality. In long lines steam conditions will vary quite a bit from initial conditions. Actual amount of condensation can be found by discharging line traps into tanks or drums and noting amount discharged in a given time. Weight can be found by calculation or weighing, the latter being the most accurate method.

Of course, this means a lot of work and some expense depending upon conditions, but it might be well worth the effort as it might reveal conditions now unsuspected.

Pittsfield, Mass. A. H. MOULTON

Check Beta Ratio

IN RESPONSE to M. J. H. concerning the discrepancy between his boiler and distribution meters, we have solved a similar problem. Our problem was aggravated by the fact that we actually sell steam to others, so we were really losing money.

Our central plant distributes steam through high-pressure mains 3000-ft long, and is then reduced to 10 psi for heating, hot water and restaurant kitchen use. The 10-lb meters were constantly reading low.

We also calibrated meters, checked specifications, etc., and found everything correct. Next step was to determine our actual steam consumption. All condensate collects in condensate receivers and by gauging the pump cut-in and cut-out points and counting the number of times the pump operated, we found our actual steam consumption in this branch to be from 2000 to 3000 lb per hr. The specifications, however, called for a 0- to 10,000-lb-per-hr meter and an 8-in. line.

Any meter specialist will tell you that the most accurate range of a flowmeter is in the middle, and below 25 per cent he will not even attempt to guarantee any accuracy. We were constantly reading in this range of 20 to 25 per cent.

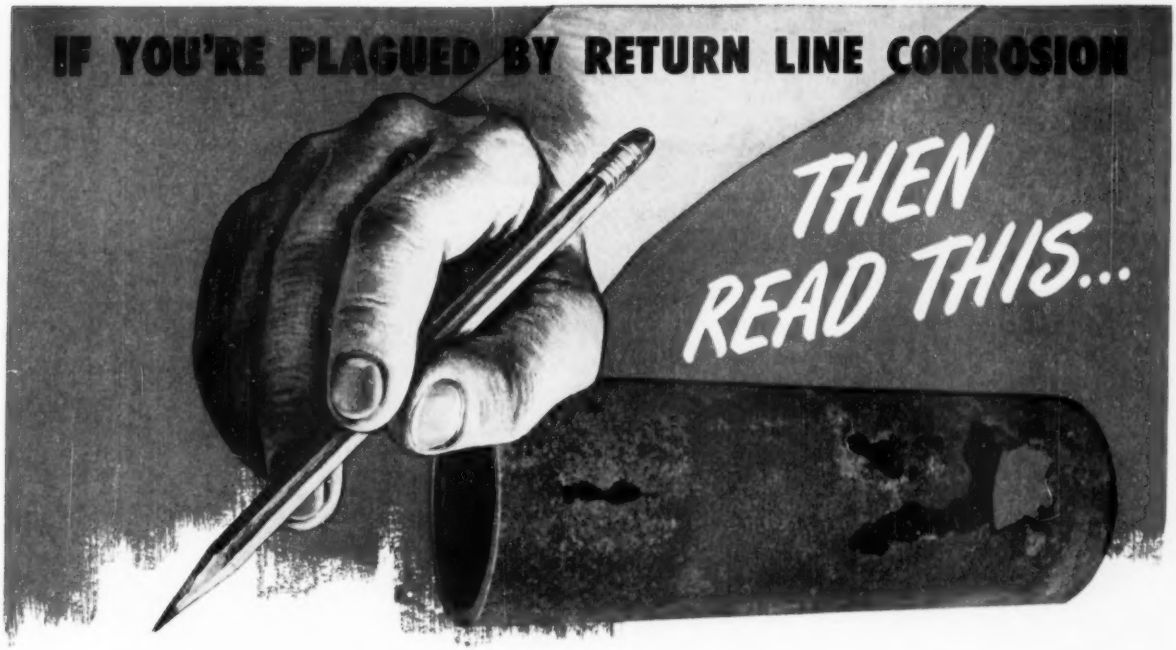
First solution attempted was to reduce orifice size. This was an improvement but since we had an 8-in. main, the Beta ratio, which is the ratio between pipe size and orifice size, was too low. For best results the Beta ratio should be around 0.75. Thus, with 8-in. pipe and a 6-in. orifice: $\frac{6}{8} = 0.75$ Beta ratio. We installed a 3-in. orifice in the 8-in. line which gave us a Beta ratio of $\frac{3}{8}$, or 0.375.

Final solution was to blank off the 8-in. line at the orifice and install a new 4-in. bypass line at this point with a new set of 4-in. flanges and a 3-in. orifice. This gave us our $\frac{3}{4}$, or 0.75 Beta ratio. No changes were necessary in the meter itself, other than to use a different multiplier for integrator readings.

Now steam flow is within 1 per cent of our calculated condensate. It is not possible for us to compare these flows with our boiler meter totals as we do not meter all steam consumption, only steam we sell. The meter manufacturer will be glad to help in this problem.

W. J. STEINERT

Fresh Meadows, N. Y.

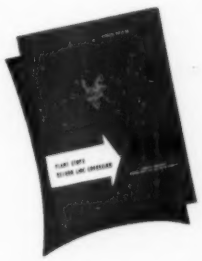


As an engineer responsible for efficient, economical plant operation, you know only too well that corrosion of steam and condensate lines can send costs skyrocketing through pipe replacement, interrupted production, and increased labor and maintenance. Perhaps you, like many other engineers, have tried stop-gap methods to check the problem only to find them partially effective or far too costly.

Realizing the importance of this major industrial problem, Betz Laboratories has developed its patented filming amine treatment. Here, at last, is a simple, inexpensive, and practically 100% effective method of eliminating this costly and production-disrupting headache.

For example, a linoleum company, operating at 150 psi and producing 300,000 pounds of steam per day, employed sodium zeolite softening for a high bicarbonate raw water. The carbon dioxide content of the steam averaged 40 ppm. Continued maintenance was required due to failure of condensate lines from the steam kettles and unit heaters. After the filming amine treatment was applied, maintenance records showed an annual saving of approximately $8,000.00! And, a large part of this saving was obtained by eliminating weekend over-time work on pipe replacements.

Why not take the first step toward ridding your plant of corrosion *now?* Call in a Betz Engineer. Ask him to show you how Betz *Specialized* Water Conditioning Service can help you . . . quickly . . . economically . . . effectively. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.



See for yourself how Betz filming amine treatment eliminates return line corrosion and reduces operating costs. Send for Technical Bulletin No. 124.

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Supplying Power to Industry

Supplying electric power to industry reliably and economically demands close cooperation between utility and industry. Here is how West Penn Power Co. and its larger customers match their systems

By F. F. DICKMANN
Senior Industrial Engineer
West Penn Power Co.

AN INDUSTRIAL power system is like a pair of pants — the user is not fully clothed unless he has a coat to match. If you buy either the coat or the pants without regard for the other, there is slight chance they will go well together. So it is with industrial and utility power systems. They should be designed to match.

Purpose of a power system is to deliver energy to the point of use as reliably and economically as possible. This is true in an electric utility. It is true in an industrial plant. When an industry purchases power, both of these systems must function. They should function in a coordinated manner just as if they were two parts of the same system.

If planning and engineering of both utility and industrial power systems were done by one qualified group, maximum economy and reliability could be expected. Each would be designed as part of a total system. While it is not often practical for one group to plan both systems, it is essential that engineering and operation of the two be coordinated. It is not difficult for two engineers to design two power systems that will operate as one. The problem is to get the two engineers together with a common objective.

The customer's engineer is usually an expert at designing an industrial power plant system, but may not be familiar with the operation of a utility system. The power company has experts at planning a utility power system, who must also have an understanding of the needs of an industrial plant. If there is to be correlation between the two, it falls to the lot of the utility to show the way.

My purpose is to describe the viewpoint of *one* power company in supplying electric service to its industrial customers and to show, by example, how both parties cooperate to their mutual benefit.

Encourage Cooperation

Most effective method of encouraging cooperation from a customer is to be cooperative. If he has a need that can be filled, or a problem that can be solved, it is just good business to help him. Lip service is not enough. A utility with its many experts, its extensive facilities and its wide knowledge can render valuable services to its customers if it is willing to step out of its main role of delivering power. It is not our desire to compete with persons in other fields of endeavor, but when a customer needs help, it pays to give it. If he wants to swap his transformers for larger ones or rent a voltage regulator, if he wants a meter tested or a pole line built, or if he wants his transformer oil filtered or a flag pole raised, it pays to help him.

By the same token, it pays to sell him the kind of electric service he wants, where he wants it. If our rates are right, it should make no difference to us what standard voltage we deliver or where we deliver it. It should matter little what power factor the customer has. If reactive kva is properly priced, the utility can make a reasonable profit selling it — and many customers will buy it.

Whether he is improving a process, selecting equipment or designing a power system, if a customer needs help of an engineering nature, it pays for the utility to furnish it. These services need not be free. A reasonable charge often adds to their value, for free service is not always held in high esteem. What is important is a wholehearted willingness to cooperate with the customer in any fashion. It is human nature to react to a person in the same way he reacts to you. Customers are no exception. Helpfulness, cooperation and consideration breed a like response and lead to a relationship that is profitable to both parties. West Penn Power Co. has followed this philosophy with its industrial customers for years, and has reaped dividends in customer

Fig. 1. West Penn facilities for serving large steel mill before expansion

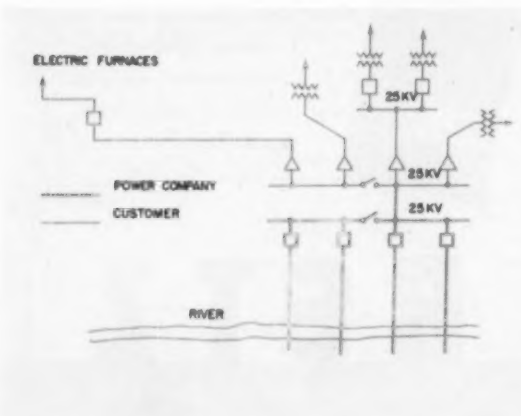
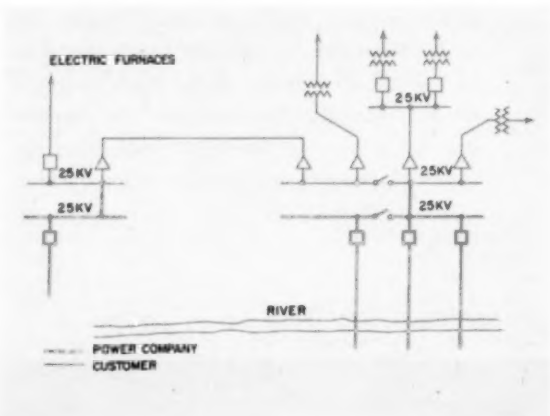


Fig. 2. Addition of 12,000-kva furnace prompted a joint switching station



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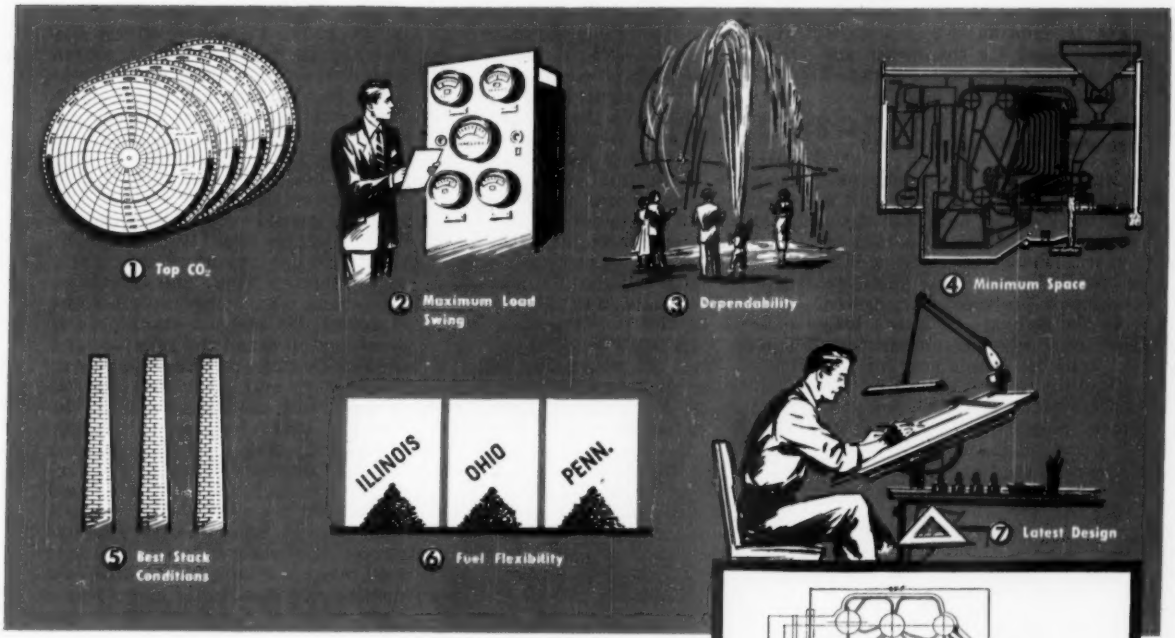

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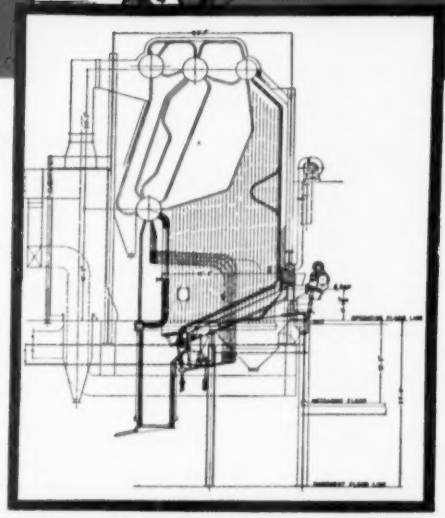

Water cooled 10-retort Taylor Stoker with Babcock & Wilcox four-drum boiler in use by the Municipal Light and Power Plant, Troy, Ohio. This unit has a capacity of 100,000 lbs. per hour and operates with an average of 14½% CO_2. Consulting engineers were William C. Kammerer and Associates of Cleveland.

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satisfaction, good relations, sales opportunities and cooperation in charting the course ahead. The following cases are examples of how West Penn and its customers find it pays to work together.

Our cooperation begins by telling each other our plans of mutual concern. Each August we contact the management of each large customer for their forecast of power usage over the next 16 months. At that time long range plans for the future are also discussed. These are translated into the effect on power usage.

Growing With a Steel Mill

For example, our power engineer called on one large steel mill with a chart of the kwh per month used by this customer over the past four or five years. Plans affecting power usage were discussed and noted on the chart as a projected line, agreed upon as the estimate of future kwh requirements. The customer's forecast of business conditions for the immediate future also influenced the curve. These forecasts are made with customers representing 75 per cent of our industrial business. The summary provides the basis for operating and construction budgets, for system planning and for determining generating capacity needs. This particular customer was in the middle of an expansion program.

Here is a plan, shown in Fig. 1, of our facilities for serving this customer in 1946 before his expansion program was begun. Total load at this plant was 35,000 to 40,000 kw, consisting largely of electric furnaces. At peak loads incoming lines were loaded to capacity and load fluctuations were such that voltage regulation was becoming poor on that part of our system. Existing buses and conductors in our substation were approaching current-carrying capacity. When the addition of a 12,000-kva furnace was approved, enlargement of our facilities became necessary. At the same time, the customer wished to have a second source of power available to his furnace circuit. The solution jointly arrived at by ourselves and the customer's engineer was to erect an additional switching station at the furnace shop.

In order to make room for the new furnace, the customer's main breaker on the furnace circuit needed to be moved out of his building. We, therefore, proposed that a joint switching station be built, as shown in Fig. 2. The customer provided the space and the foundations. We furnished and erected a two-bay steel structure. On one side of the structure are West Penn's facilities, on the other are the customer's, and they are connected together through a meter. A small concrete block building which the customer owned was turned into a joint control and meter house. As the customer's expansion program progressed, a new electrically-driven bloomer was ordered to replace a steam-driven mill, and the following changes in the power system were agreed upon (see Fig. 3):

(1) West Penn would build a 132-kv line to the plant.

(2) West Penn would install two 30,000-kva transformers from 132 kv to 25 kv.

(3) The customer would build a new substation and rearrange his 25-kv step-down transformers on two separate buses.

Several problems, such as these, arose in executing the changes:

(1) The customer's 25-kv breakers would have insufficient interrupting capacity. He ordered new ones and sold the old ones to West Penn.

(2) The reconstruction of the customer's transformer station would put his 460-v supply out of service for several weeks. West Penn moved in a 2000-kva bank, erected a temporary substation inside the customer's plant, connected it to one of his 25-kv circuits, charged him for the construction work and rented him the transformers.

Minimum Interruption

It was the customer's desire to assure uninterrupted service to the mill. In his new substation the three transformer banks on each bus would give two separate sources for each of the three mill voltages. The banks of like voltage were interconnected on the low voltage side. Our problem was to separate the incoming sources.

It was done in this manner. The main bus was split and each half supplied through breakers from the 132-kv bank. Each half of the bus also has an incoming 25-kv source from our network. The same situation exists at the furnace location. This arrangement, of course, required coordination of the customer's relay equipment, particularly since there is bus differential and ground relay protection on the whole 25-kv system shown. In order to assure correlation of this phase of the installation, our relay engineer made a trip to the factory where the substation equipment was being built for the customer. He and the manufacturer developed in detail the selection and connection of the relaying equipment.

Our work and the customer's was in process of construction when the August, 1948, forecast, previously mentioned, was made. Additional electric furnaces totaling 32,000 connected kva had just been authorized and 23,000 kva more were noted as a "hot project," and shortly were approved. The exact nature of the new load was uncertain, since these new melting facilities would operate at a higher arc voltage than any in our experience or in the customer's experience.

A joint study was undertaken to determine the probable maximum load and the amount of reactive kva involved. All knowledge we could gather was pooled and conclusions finally reached. It was readily apparent that West Penn facilities under construction would not be sufficient to serve the addition. A second 132-kva substation was finally decided upon, as shown in Fig. 4. Again it seemed desirable to conserve space and money by erecting a joint 25-kv switching station. Again, the cus-

Fig. 3. Mill's continued expansion caused these changes in the power system

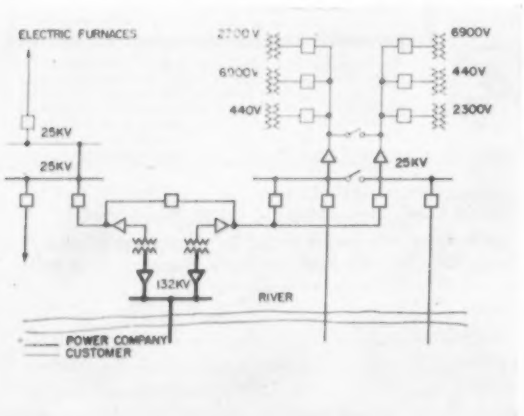
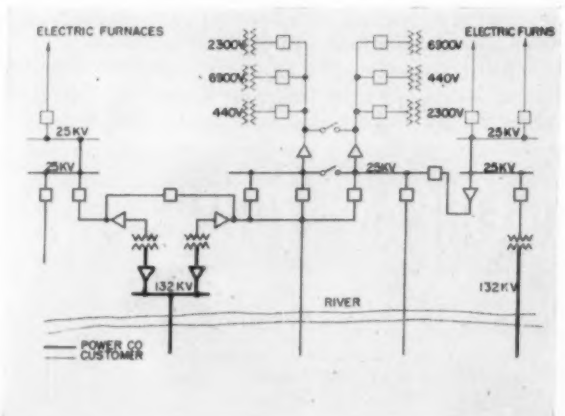
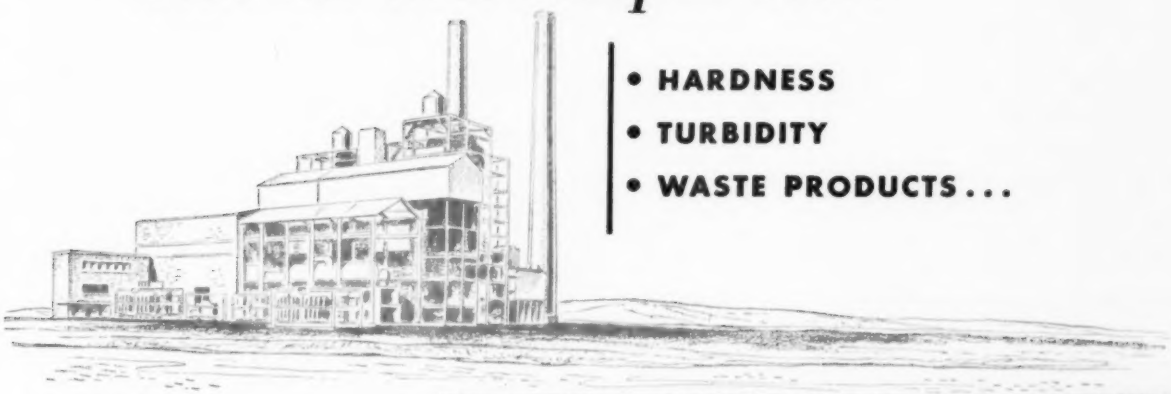


Fig. 4. Construction based on 1948 forecast was altered to fit new demands



Raw Water Supply with all these impurities:



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- **TURBIDITY**
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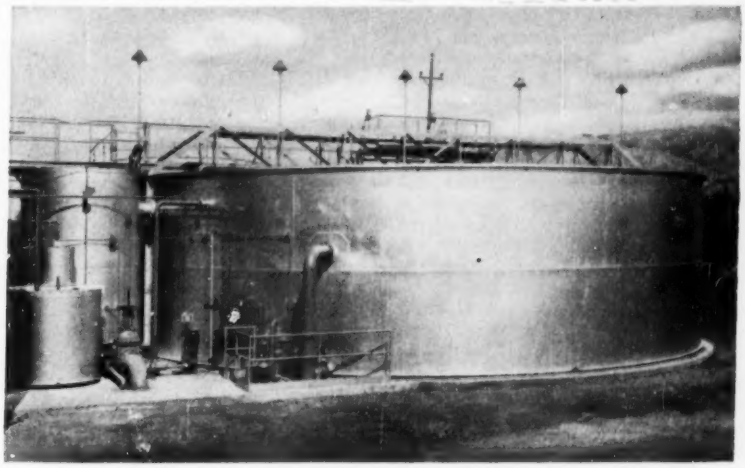

This raw water supply is poor . . . very poor . . .

- ***The total hardness ranges from 350 ppm to 700 ppm.***
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- ***It may contain sugar beet pulp and various other vegetable and animal wastes.***
- ***The organic pollution is so high that chlorine pretreatment is required.***

The raw water is used for the cooling tower make-up. The Graver engineers were consulted, and a 3000 gpm Graver Reactivator designed to reduce total hardness to 250 ppm and turbidity to less than 10 ppm was installed.

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Graver Reactivator at Gadsby Plant of Utah Power & Light Co. Also in this plant the make-up for a boiler with a capacity of 620,000 pounds of steam per hour goes through Graver Filters and Automatic Zeolite Softeners which reduce the hardness to zero before passing to evaporators.

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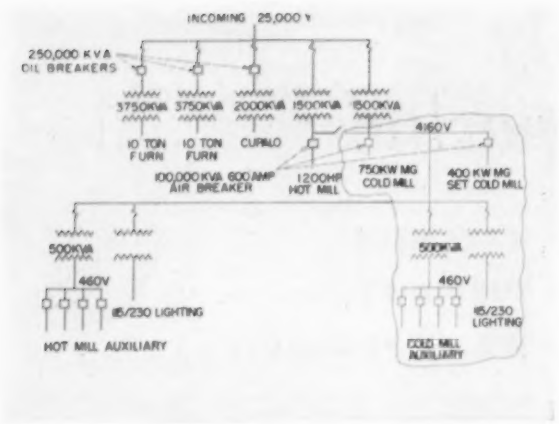


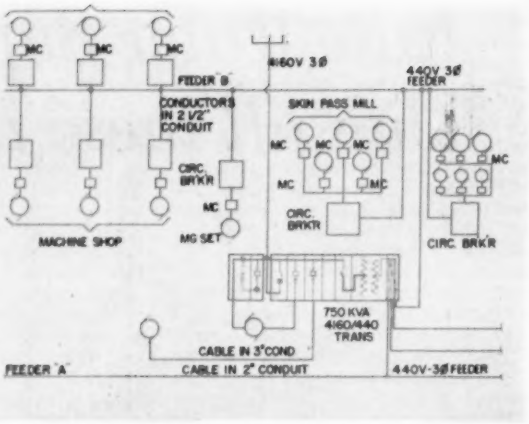


Fig. 5. This power system was laid out for plant customer intended to build

Fig. 6. Part of the wiring layout for new plant made by West Penn engineers

tomer built the foundations and West Penn erected the steel. We have one breaker and metering equipment in the station, and the customer has two breakers on the outgoing lines to his new furnace shop. Standard West Penn arresters, insulators, disconnects and miscellaneous material were supplied from our stock and can be replaced readily if a failure occurs.

As a result of careful planning, the program was completed with practically no interruption to production, and at minimum cost. Both we and the customer are assured that the system will provide the desired results. As in this case, several years may pass before a program is completed. Progress of the work must be closely followed for changes in plans by either party.

Here is an example of planning, with a new customer, power supply for a new plant. In 1945 two men with vision and experience in steel making organized a steel company. While the company consisted of only these two men and a stenographer, they came to us for an estimate of power costs to operate the plant they would build, and for any other help we might offer. A conference was held with the owners and their consulting engineer. Their ultimate plans and hopes for the future were laid on the table. We accepted the responsibility of guiding the customer in matters relating to power.

Helping New Customer

The first job was to recommend a selection of voltages. This was tackled by first laying out a power system for the plant which the customer ultimately expected to build, and coordinating it with West Penn's local system. Two voltages, 25,000 and 4,160, were available in that area from a nearby substation. With these as an influence, this system, shown in Fig. 5, was laid out as one that would be adequate for an integrated mill which it was hoped would develop within a few years. Size of the load required that the incoming line be 25,000 v. For electric melting facilities direct step-down from the 25-kv system would be controlled by a breaker on the high side of each furnace transformer. For the distribution voltage within the plant, 4,160 v was selected to be supplied by 1500-kva three-phase transformers.

In this selection we urged the customer to purchase transformers standard with us so that in case of a transformer failure, one of ours would readily fill their needs. In the interest of economy, it was recommended that transformers be protected by fused disconnects rather than breakers. The large motors would be 4,160 v and the small motors would be 460 v supplied from unit substations. Lighting would be 115/230 v, single-phase, supplied from small lighting transformers.

Change In Plans

Since only the cold roll mill was constructed, only that part of the power system was required. As this load was within the capacity of our existing 4,160-v facilities, it was not necessary to construct any 25-kv facilities.

When the mill equipment had been selected and laid out as to location, prints were furnished to us for the purpose of laying out the wiring system. Figure 6 shows a part of the wiring layout, including the incoming line and distribution center. A similar layout was made for lighting.

West Penn's 4,160-v facilities were adequate to take full voltage starting of the 400-kw MG set, but inrush on starting the 900-kw set could not be tolerated and a reduced voltage starter was recommended. Later when the incoming supply is changed to 25 kv, full voltage starting of this machine will be acceptable, and the starting breaker can be eliminated and used for some other purpose.

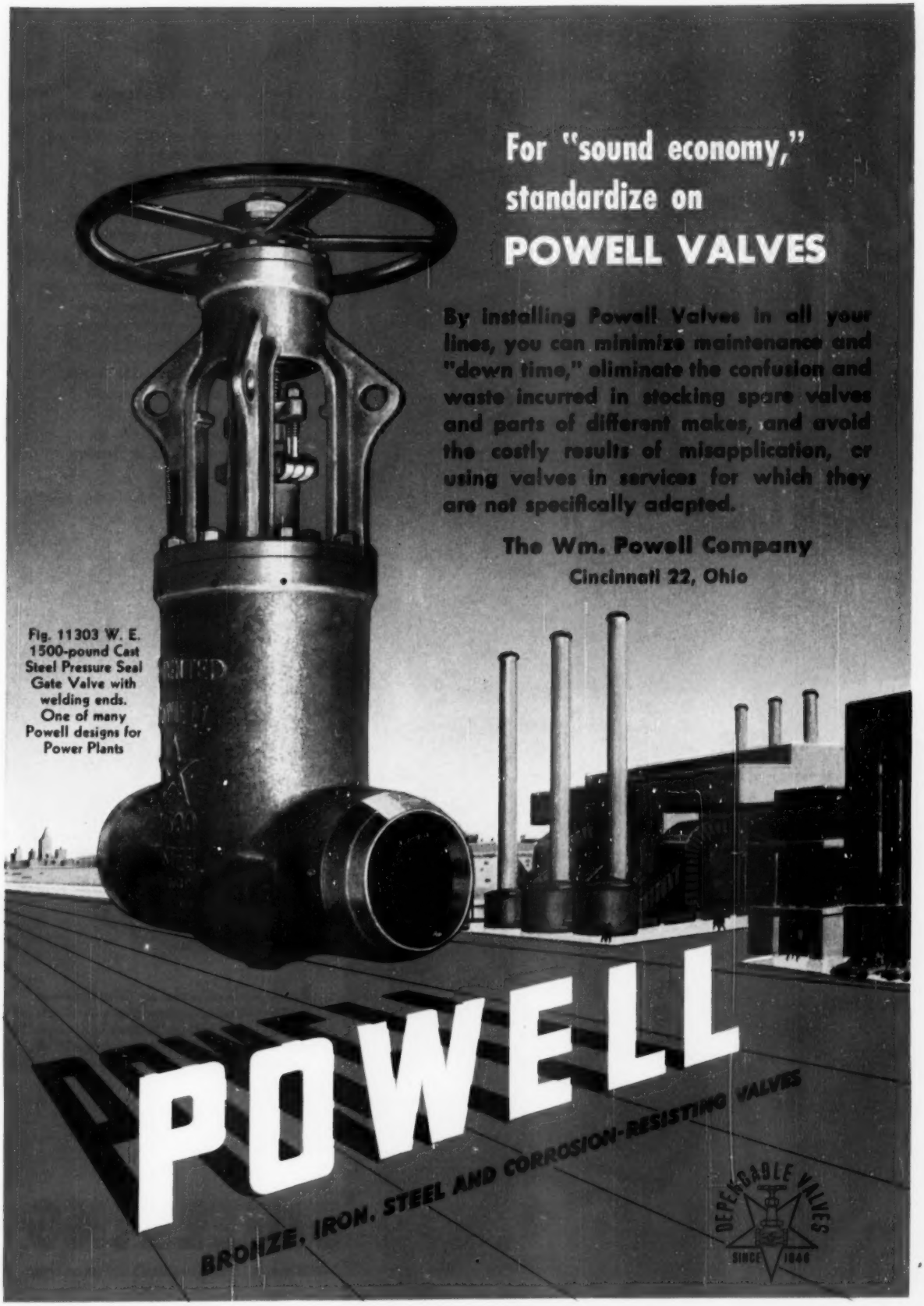
In the selection of the 4,160-v control equipment, the customer brought the manufacturer to our office to consult with our engineers to make sure relays and other protective devices would be properly selected and correlated with our facilities. The 4,160-v breakers were selected with interrupting capacity that would ultimately be desirable. Construction was undertaken at a time when materials were scarce and deliveries long. The customer had no resources of supplies and equipment to fall back upon and in a number of instances called upon us for help. When he couldn't find cable for his incoming line, we sold him some from our stock. Delivery of their unit substation was delayed and in order for the plant to get in operation at the earliest date, we reconnected an old rotary transformer from our railway system and moved it into the plant. We dug an old oil breaker out of the junk pile for an incoming switch, and production started months earlier than would otherwise have been the case.

Of course, we put ourselves out to do these things, which could be considered outside the realm of supplying power to an industry; but when we add up the results, it is obvious that we can't afford to do business on any other basis. The customer's operation became profitable to him earlier. We started selling power to him earlier. The customer has a power system that functions properly and can be expanded readily with no change in present equipment. We spent a minimum of money in extending our facilities to this customer and our plans are laid for serving the additional load which will come to us as this plant develops into an integrated mill.

Power To Coal Mines

Twenty-five per cent of the industrial load in our area is coal mining. Supplying power to this industry poses problems which are not found elsewhere. In the course of a few years, coal in a specific area will be exhausted and there will no longer be requirements for power. Energy must be delivered to equipment that is slowly, but constantly, moving. In planning extension of a power system

(*Continued on page 102*)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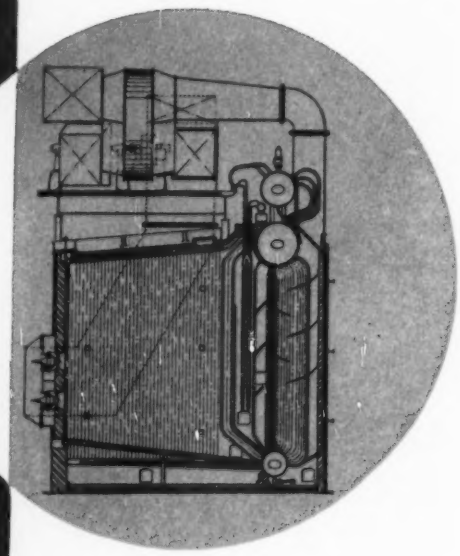
one

VU



1. VU-50 Unit, installed in a Petroleum Refinery. Burning natural gas and oil, the unit has a capacity of 260,000 lb of steam per hr at an operating pressure of 400 psi and steam temperature of 660 F.

COMBUSTION ENGINEERING

SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

It seems that the story *never ends* with the purchase of the first Vertical-Unit Boiler. Company after company has installed a VU unit . . . liked it . . . and then bought another — and another — and often another. This is true in every branch of industry, but the three typical examples described below and illustrated by the accompanying drawings will serve to illustrate the point.

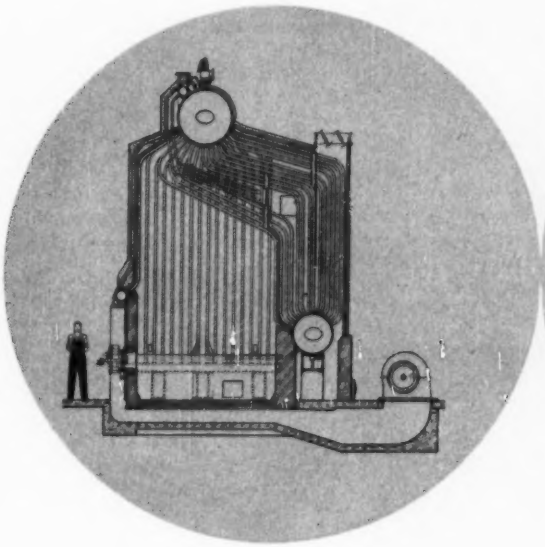
A Petroleum Refinery (1) ordered its first Vertical-Unit Boiler in 1937. A second VU Unit was installed in 1941, and a third in 1950. For another of its plants, two VU Units were ordered in 1942; a third, in 1947.

An Automobile Company (2) installed its first two VU Units in 1947. Two more were ordered for another of its plants in 1948; then three more units for a third plant in 1949 and two more for still another plant in 1950.

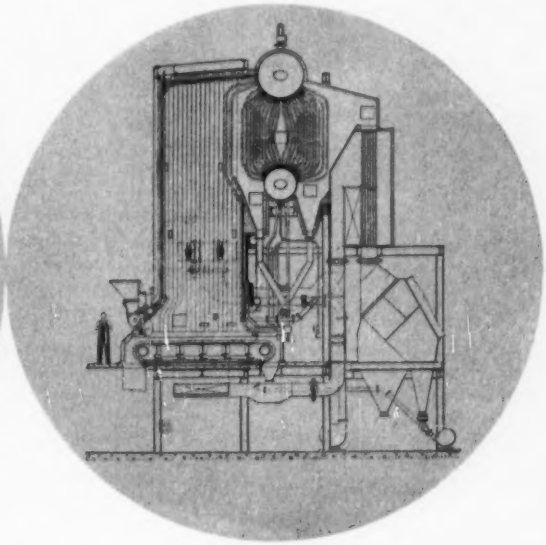
A Chemical Company (3) ordered two VU Boilers in 1939. In 1946, five more were ordered for three of their other plants. In 1949, two more were ordered for one of these same plants, and in 1950 two more units for a fifth plant. In 1951, seven more VU Units were ordered for still another plant — eighteen units for six plants in twelve years!

• • •

And so it goes — in all sections of the country — companies representing every type of industry . . . paper, food, mining and metal working, brewing, rayon, aircraft — and many others in addition to the examples pictured here . . . ordering and reordering VU Boilers. There must be a reason — and there is. It's lower steam costs and top reliability. These companies have found *through experience* what they can expect in economy and performance when they buy VU Boilers.



2. VU-10 Unit, one of three duplicates installed in an automobile plant. It is fired with oil or gas. VU-10 Boilers range in capacity from 10,000 to 60,000 lb of steam per hr. They may also be fired by spreader, underfeed or traveling grate stokers.



3. VU-40 Unit, one of seven, now being installed in a Chemical Plant. These boilers will be fired with C-E Spreader Stokers (continuous discharge type). The capacity of each is 60,000 lb of steam per hr at an operating pressure of 325 psi; no superheat.

B-639

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C-E

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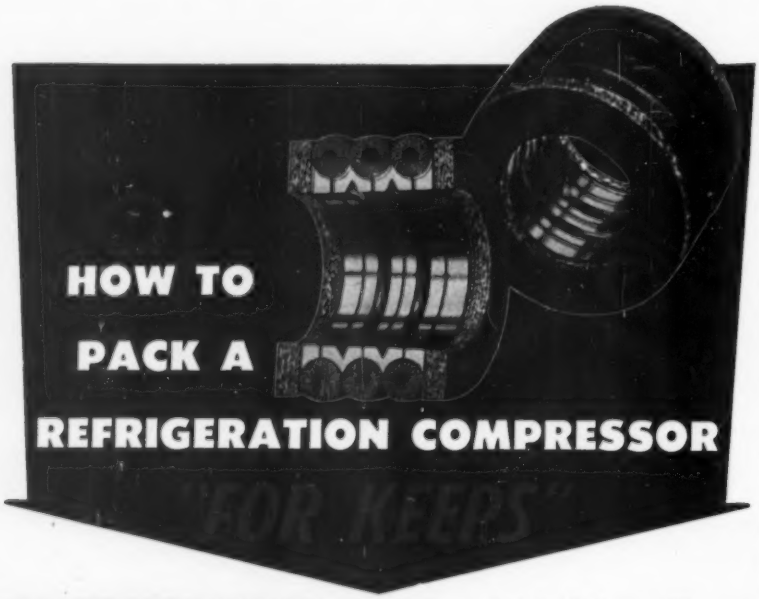
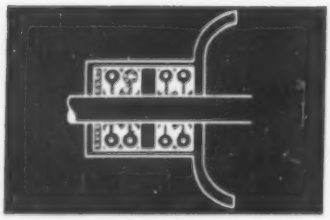
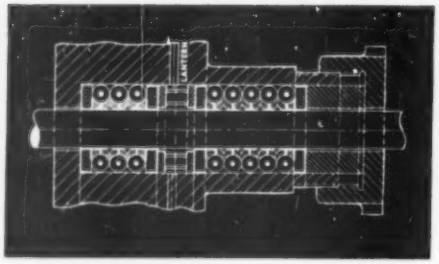
Chesterton 444





Chesterton 444 is full metallic on rod or shaft. It runs frictionless without usual gland pressure. Why? It's due to E-L-A-S-T-I-C back and *built-in oil seal* in each Metallic ring. These special metal rings are soft enough to machine themselves to rod imperfections. 8 to 10 years uninterrupted service is common with Chesterton 444.

Chesterton 444, formerly Austin-Mason, is the most famous name in refrigeration packing. Easy to install — each ring is cut so it may be opened to fit over rod or shaft. Full directions accompany every set. Unexcelled for Ammonia, Freon, CO_2, steam, brine, air and other liquids and gases.



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America's Oldest Manufacturer of Mechanical Packing

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SUPPLYING POWER TO INDUSTRY

(*Continued from page 98*)

to supply these changing loads, it is of particular importance to know where these loads will go. It is not enough to know what the customer's next move is going to be, but what his probable moves will be over the next 5 or 10 years, so that our System Planning can economically develop facilities for these changing conditions.

Since most large mines lay out their underground activities on a long range basis, their plans can readily serve as a basis for ours.

Growth of the West Penn system to keep pace with a mine's development is laid out years before actual construction. Plans for the next few years are based on very definite knowledge of the size and location of the customer's requirements. Even before the customer has purchased the site for a surface installation, he shows us the approximate location. He knows he can expect better service from us if we are kept fully informed. With this kind of planning we are able to lay out a network which will provide service with a high degree of reliability.

Customer's distribution centers and West Penn substations are jointly engineered by the two companies. At one large mine, transformer stations are 1500 to 3000 kw at each shaft location. From West Penn transformers, 2300-v buses go through this customer's building wall into a row of cubicles. A section of these cubicles is owned by West Penn and houses control equipment for the substation. These West Penn cubicles were built to match the customer's in size and color so as to make a pleasing appearance. When the customer engineered the building, ducts from the substation yard were provided for the West Penn control cables. A common battery voltage was selected and the customer purchased his control battery with sufficient capacity to operate the West Penn breakers, making it unnecessary for West Penn to maintain a separate battery.

Planning of this kind has produced results which are valuable to the customer and to us. There should be no duplication of equipment, for each party knows what the other plans to do. When either system needs to be expanded it can be done at lowest cost. The operation of the systems will be properly coordinated to assure good service with a minimum of outages.

It is good business on the part of the utility and the customer to operate on the basis of mutual helpfulness. Understanding and confidence in each other grows. Business negotiations are simplified, and warm personal friendships that make life more pleasant are created.

New ENGINEERING BOOKS

Work Measurement by Adam Abruzzi. Size 6 by 9 in.; 290 pp; cloth bound. Published by Columbia University Press, 2960 Broadway, New York 27, N. Y. Price $6.00.

This book presents objective ways for establishing standards and identifying factors that have a bearing on the results in work measurement. It points out how to closely predict the performance of workers and how to set up standards that are practical.

Industrial engineers, interested in work measurement can find this volume useful in establishing a scientific approach to their studies. Besides, it can be of help in acquainting labor and management people with thinking that deemphasizes the bargaining factor in work evaluation.

Throughout the book are found 25 figures and 55 tables as additional aid to the reader. Some of the subjects covered by this volume are as follows: case studies of local stability; developing standard data for operation elements and motions; the relationship among operation elements; comparing the work methods of different operators and measuring and estimating delay factors.

★ ★ ★

Practical Metallurgy for Engineers. Fifth edition; size 5½ by 8½ in.; 599 pp; illustrated; cloth bound. Published by E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa. Price $3.50.

In this revised edition, are covered the recent advances that have taken place in the metal industry. Beginning with fundamentals, the book discusses various metals, alloys and processes. Extensive coverage is given to heat treatment of metals.

A discussion on steel classification is included. Both the A.I.S.I. and S.A.E. systems are mentioned. Tables in the book present a variety of steel designations along with the chemical composition by percentage. The back portion of the book carries useful standard technical reference data.

Heat treating, liquid salt baths, cleaning procedure and control, testing and inspection, grain size and hardenability, and temperature measurement are some of the subjects in this informative book.

★ ★ ★

A Treatise on Milling and Milling Machines. Third edition; size 9¼ by 6¼ in.; 896 pp excluding index; illustrated; cloth bound. Published by the Cincinnati Milling Machine Co., Cincinnati 9, Ohio. Price $8.00 ppd.

This book combines theory and practice to bring before the reader one of the most thorough studies on milling. Milling machines of various types, from the simple to the very complex, are covered in the introductory chapter. Then, the book goes on to the classification and uses of accessories, cutters, cutting and so on.

(Continued on page 104)

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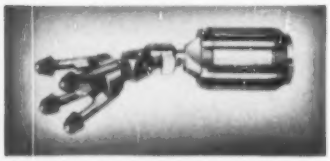
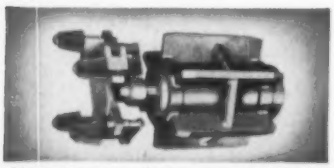


Motor with sleeve, universal coupling and type H-2 head.



Sleeved motor and Quick Repair head for large pipe. Can also be fitted with universal joint for curved sections.

For pipe sizes up to 6 in., standard Lagonda cleaners are used. Above 6 in. the Lagonda 1100 Series motor is sleeved to the pipe size and equipped with suitable Lagonda cutter head. They will clean pipe up to 20 in. inside diameter, straight or curved.

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NEW ENGINEERING BOOKS

(Continued)

Over 50 pages are given to the milling process, covering fundamentals, methods and elements. An entire chapter reports on production milling and offers examples along with relative formulas on cycle time per piece. The book also goes through an example on replacement using the MAPI replacement analysis.

Engineers as well as operators and others will find this book filled with a lot of milling knowledge which includes 200 formulas for working shop problems and over 700 illustrations and charts.

Power required in milling, the use of work indexing in repetitive milling operations, sharpening and care of milling cutters, fixtures and fixture design are titles of some of the 19 chapters in the book.

★ ★ ★

Electrical References by E. S. Lincoln. Second edition; 8¼ by 11 in.; 1744 pp; illustrated; cloth bound. Published by the Electrical Modernization Bureau Inc., New York 17, N. Y. $25.00.

Since modern plants rely heavily on the use of electricity, this form of energy often comes into the limelight in discussion. To help plant engineers and others in their responsibilities and search for further know-how on the subject this revised edition should go a long way.

The book's 26 sections present a wide range coverage of reference material. Consideration is given to both the industrial and commercial aspects. Material on inspection and maintenance is included in the text.

Industrial wiring, systems, electric furnaces, electric heating, electronic equipment, electroplating and electrolysis, electric measurements and electric surveys are titles of some of the 26 main divisions in the book.

★ ★ ★

Mathematical Engineering Analysis by Rufus Oldenburger. Size 6 by 9¼ in.; 426 pp; illustrated; cloth bound. Published in 1950 by The MacMillan Co., 60 Fifth Ave., New York 11, N. Y. Price $6.00.

This highly technical book presents ways of translating physical engineering happenings into representative mathematical language. To grasp the teachings of this work, the interested reader should have a background of advanced physics and mathematics.

The book is conveniently arranged in five sections. Each one separately treats subjects that fall into a specific category of physics. The following are titles of the various parts: mechanics of rigid bodies; electricity and magnetism; heat; elasticity and fluid mechanics.

The author instructively presents the mathematical aspects of a variety of conditions and problems pertaining to each specific division heading in the book.

★ ★ ★

Copyright, Design and Patent Guide by Henry J. E. Metzler. Size 5½ by 8½ in.; 125 pp; illustrated; paper bound. Published

by Ameliorant Co., Inc., P.O. Box 108, Halesite, L. I., N. Y. Price $2.00.

Here's a book that can be of help in clearing up important points on patent and copyright laws. Clearly written, the text is such that it offers information to men in many lines of endeavour. It is not aimed strictly at the members of the legal profession.

What can be protected? How to acquire copyright protection? Who may obtain a patent? What may be patented? These are questions which the author poses and then proceeds to clear them up individually.

Some of the other subjects covered by this guide are: copyright infringement and remedies; mechanical elements; small ideas; importance of prompt application for a patent and patent claims.

★ ★ ★

I.E.S. Lighting Handbook. Second edition; size 6 by 9 in.; 987 pp; illustrated; cloth bound. Published by the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y. Price $8.00.

Packed with facts and figures, this handy book brings before the reader a solid coverage of the subject of lighting. Starting with basic physics, the book goes into color, control, light sources, calculations, lighting for different purposes and miscellaneous applications of radian energy.

The section in the back carries extensive manufacturer's reference data which has been checked to comply with I.E.S. specifications and standards.

The current edition has more pages than the 1947 edition by 15 per cent. A great deal of effort was put into revision work which produced a 75 per cent change in the subject matter.

Here are a few of the many subjects appearing in this handbook: natural phenomena; steps in working out a lighting design; electrical measurement of fluorescent lamp circuits; color harmony; reflection; group replacement; maintenance of lighting and office lighting.

★ ★ ★

National Electrical Code Handbook by Arthur L. Abbott. 7th edition; size 5 by 7⅞ in.; 652 pp; illustrated; cloth bound. Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York 36, N. Y. Price $6.00.

This is a useful book for plant electrical work. It brings assurance that a job is not just being done but that it is carried out according to code requirements. Plant changes often require electrical changes. Questions may arise as to wire sizes, protective devices, conduit limitations and so forth. This revised edition based on the 1951 national electrical code can answer many queries of that nature.

There are six main sections in this handbook, namely definitions, approved types of wiring, installation of materials and apparatus, general requirements for wiring installations, special installations and equipment, and construction of materials. This includes a chapter containing 34 reference tables.

The same key to code requirements ap-

(*Continued on page 106*)

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True Ball Joint—Dart seats are spherically ground to form wide, true-bearing surfaces. Seats remain unscarred and true — always in shape for repeat use. Used over and over again — Darts stay tight without jamming.

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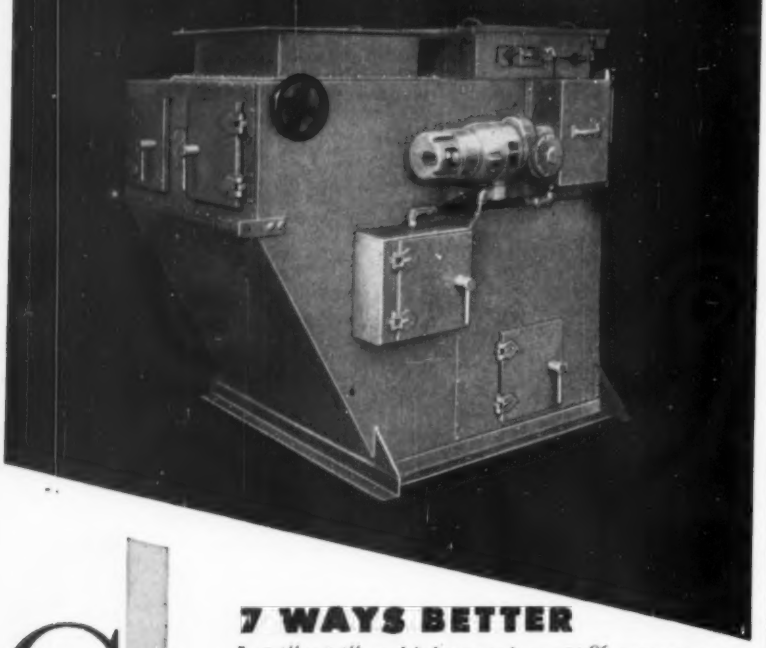

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NEW ENGINEERING BOOKS

(Continued)

pears in the front as well as in the back of the book. Thus, material can be picked out whether one opens the front cover or the back cover.

★ ★ ★

Industrial Furnaces by W. Trinks. Fourth edition; size 6 by 9 in.; 526 pp including index; cloth bound. Published by John Wiley and Sons Inc., 440 Fourth Ave., New York 16, N. Y. Price $10.00.

This guide on industrial furnace practice contains many changes and improvements over previous editions. Revisions tend to keep designers and users of industrial furnaces up to date.

Conclusions to theories which have been tested in actual furnace practice are offered in this book. Basic principles underlying all furnace design and operations are presented and discussed.

The introductory chapter sets down some furnace fundamentals. The remaining five sections carry information on the following subjects; heat saving appliances; strength and durability; movement of gases; fuel economy and heating capacity. The appendix contains tables, charts, recuperator and regenerator calculations and so forth.

★ ★ ★

Personnel Series, Size 6 by 9 in.; paper bound. Published by the American Management Association, 330 West 42nd St., New York 18, N. Y.

Practical Methods of Management Development, No. 137, price $1.25, 32 pp. The major portion of this pamphlet carries information on planned executive development based on experience at one of the country's leading merchandising organizations. About 5 pages of the publication present information on the use of tests in the selection of supervisors.

Tools for Improved Personnel Relations, booklet No. 140, price $1.25, 44 pp. This publication contains the text of the papers presented at the Midwinter Personnel Conference in Feb., 1951, in Chicago. Subjects discussed are: productivity; job evaluation; organization control; employee self-appraisal; training manual for union stewards and profit sharing.

★ ★ ★

Industrial Piping by Charles T. Littleton. Size 6 by 9 in.; 394 pp including index; illustrated; cloth bound. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price $8.00.

This book explains the correct procedure for designing and erecting a modern industrial plant, from preliminary flow sheet and plot plan to the final erection drawings.

It describes the methods commonly used for solving such problems as the sizing of pipes, the determining of pressure drop, and features a listing of valve equivalents in the pressure classes up to 600 lb.

All pertinent data and methods suitable for each type of piping service are presented in individual chapters that discuss the flow

calculations, preferred materials, fittings and valves for that particular service. This coverage includes steam, water, oil, gas, air and instrument piping.

A special chapter Estimating Piping Costs, contributed by R. A. Dickson of Standard Oil of New Jersey, describes the N factor system that he has developed. It is accurate to within 8 per cent (plus or minus) of a detailed cost estimate and eliminates many routine calculations.

★ ★ ★

Nomographic Charts by C. Albert Kulmann; 1st Edition; 244 pages; illustrated; size 7½ by 10 in.; cloth; published by McGraw-Hill Book Co., 330 W. 42nd St., New York 18, N. Y. Price $6.50.

If you are interested in making speedy mathematical computations, in a wide variety of engineering fields, this book will prove very useful. Charts are included for such fields as hydraulics, mechanics, thermodynamics, electrical engineering, and some general subject handy charts.

Each chart covers a full page with a concise explanation for its proper use on the facing page. The greatest value of these charts is the time saving effected by obviating the need for looking up in various tables the values of the various items in the problem. For instance, where factors in a problem may be modified by exponential functions or varying empirical multipliers or similar variations the chart scalings have taken them into account. The accuracy of these charts are also beyond that of a slide rule.

The nomograms are not all of the alignment type. In many cases there are intersection nomograms or combinations of intersection and alignment nomograms.

★ ★ ★

How to Improve Engineering-Management Communications prepared by the National Society of Professional Engineers. Size 6 by 9 in.; 46 pp; illustrated; paper bound. Published by the National Society of Professional Engineers, 1121 Fifteenth St., N.W., Washington 5, D. C. Price $2.00 to nonmembers, $1.00 to members.

This report is a result of a survey response from some 350 companies employing more than 45,000 engineers and operating 1,000 plants. It is quite thorough in its coverage and despite its size presents an excellent experience on the subject. The booklet lends itself to comparatively easy, understandable and informative reading.

Among the seven chapters found in this publication are the following: what engineers want to know about management policy; developing management potential in trained engineers; how management gets the opinions of its engineers and how to improve communications; summary and recommendations.

A highlight of one of the chapters is a discussion of the new meeting technique — Phillips 6-6 — developed by Professor D. Phillips of Michigan State College. Also, a page of suggested readings on communications is found in the back of the booklet.

(Continued on page 108)

Niagara's HYGROL DRIES AIR BEST
with exact moisture content

- to control your product's quality
- to prevent condensation on your product or material
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- to protect your material from dampness
- to protect your processing of moisture-sensitive material
- to DRY your material or product
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- to get exact moisture control for the precise atmosphere condition you need
- to provide precise atmospheric conditions for testing
- to increase your air conditioning capacity
- to DRY large quantities of fresh air from outdoors

The Niagara's Controlled Humidity Method using HYGROL moisture-absorbent liquid is

Best and most effective because . . . it removes moisture as a separate function from cooling or heating and so gives a precise result constantly and always. Niagara machines using liquid contact means of drying air have given over 20 years of service.

Most reliable because . . . the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions.

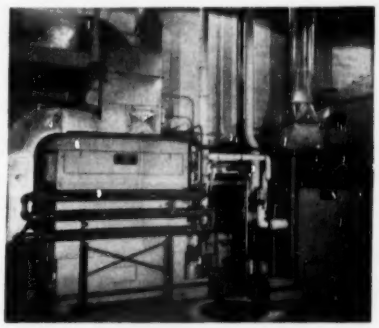
Most flexible because . . . you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

Easiest to take care of because . . . the apparatus is simple, parts are accessible, controls are trustworthy.

Most compact, taking less space for installation.

Inexpensive to operate because . . . no re-heat is needed to obtain the relative humidity you wish in normal temperature ranges and frequently no refrigeration is used to remove moisture.

The cleanest because . . . no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.



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This method removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the leaving air. Heating or cooling is done as a separate function.

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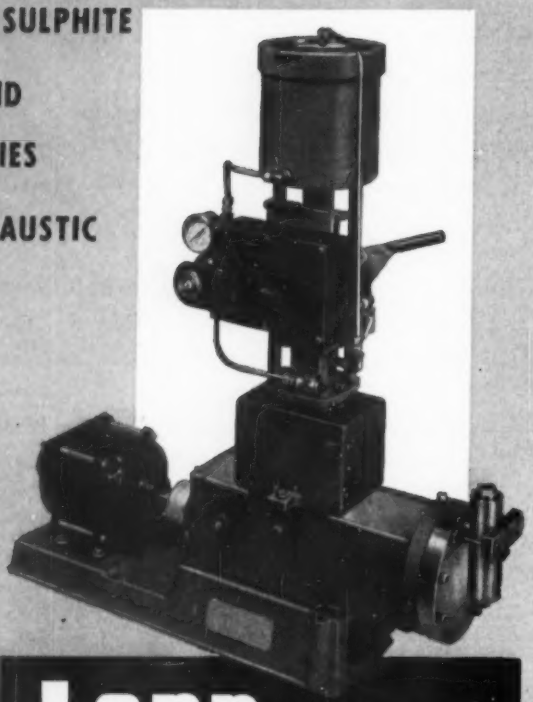

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NEW ENGINEERING BOOKS

(*Continued*)

Proceedings of the National Electronics Conference. Size 6¼ by 9¼ in.; 607 pp; illustrated; cloth bound. Published by National Electronics Conference, Inc., 852 East 83rd St., Chicago 19, Ill. Price $5.00.

Papers and digests of papers which were presented at the 1951 electronics conference in Chicago are offered by this book. Material covered is, generally, of a highly technical nature.

Seventy-nine papers were used to compile this volume. These cover a wide range of subjects in the study of electronics. Some of these are: audio systems; analog computers; magnetic amplifiers; medical applications; industrial applications; industrial inspection and measurement.

The appendices section of the book carries the contents of six previous volumes, reporting on conferences of other years.

★ ★ ★

The Grinding Wheel by K. B. Lewis. Size 6 by 9 in.; 409 pp including index; illustrated; cloth bound. Published under the auspices of The Grinding Wheel Institute, Greendale, Mass. Price $3.50.

Written in a clear and understandable style, this book offers the reader a solid grounding in the fundamentals of abrasive technology. Individual attention is given to a number of grinding methods that are common to industry. A short historical background on some of these tends to flavor the text.

In the initial chapters, the author goes into the subject of abrasive materials and tells about the making of a grinding wheel. Some of the other topics covered by the book are: crush forming; honing, lapping, and superfinishing; grinding non-metallics; crank and cam grinding and the factors affecting wheel selection.

An appendix carries useful information: such as grinding wheel safety; causes and correction of common grinding errors and a glossary of grinding terms.

★ ★ ★

Synchronous Machines — Theory and Performance — by Charles Concordia, 1st Edition; 224 pages; illustrated; size 6 by 9 in.; cloth; published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price $5.50.

This book is intended primarily for the engineer who wants to learn something about the transient performance of synchronous machines with regard to the calculation of transient short-circuit currents and torques; steady-state power, torque, and current, both in synchronous operation and during starting; and the voltage disturbances caused by the sudden application of load.

Use of the general equations developed in this book will allow the engineer to predict machine performance under these conditions. Emphasis is placed on the mathematical development and a fundamental physical understanding of the machine so that the engineer can extend the theory as he needs it.

Nomography and Empirical Equations by Lee H. Johnson. Size 5¾ by 9 in.; 150 pp including index; cloth bound. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. Price $3.75.

The graphical method of finding answers to formulas and equations is covered by this book. The author gives the reader a carefully prepared and thorough treatment of the factors involved in the actual construction of specific nomographs.

The use of nomographs may be of importance to engineers who are burdened with the repetitive substitution of data in formulas. With the aid of the scales that they set up, based on available data, they can find answers quickly.

About one third of the book is devoted to curve fitting. This is a method of establishing a definite equation based on data that have been previously collected and plotted.

Combined nomography, recurrent variables, parallel and perpendicular index lines and curves of four constants are some of the chapters found in this book.

★ ★ ★

Exhaust Hoods by J. M. DallaValle. Second edition; size 6 by 9 in.; illustrated; cloth bound; 146 pp including index. Published by The Industrial Press, 148 Lafayette St., New York 13, N. Y. Price $3.50.

Enlarged from the pamphlet form in which it was originally published, this second edition gives comprehensive information on the flow of air around and into the openings, hoods, or slots in exhaust ventilating systems.

The book is organized in chapters in accordance with hood types rather than specific applications. Chapters deal with various aspects of theory, including flow of gases, velocity characteristics, actual hood design and the essentials of hood construction.

The book is intended for plant engineers and others having problems requiring the use of local exhaust ventilation.

★ ★ ★

Vibration and Shock Isolation by Charles E. Crede; 1st Edition; 328 pages; illustrated; size 6 by 9 in.; cloth; published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y.; price $6.50.

This is a good practical reference book on the principles of isolation, the design of isolators (shock mounts) and their application to protect equipment and machinery from vibration.

Isolation is treated from the analytical viewpoint which mathematically inclined engineers will find interesting and from the descriptive viewpoint which other engineers will find useful.

The material is well arranged. In the front of the book is a notation of all symbols used and an introductory discussion of the mathematical and physical concepts used later. From this point there is a logical progression from elementary to complex isolation systems, to materials for isolators and finally, applications of the previously developed basic theory.

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Fig. 4001/6561. Duplex unit consisting of Straightway Lever-operated Sealing Valve and Angle Blowing Valve.

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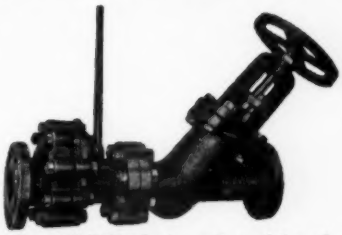

Fig. 4001/6571. Duplex unit consisting of Straightway Lever-operated Sealing Valve and Y Blowing Valve.

Fig. 6571/6561. Duplex unit consisting of Y Sealing Valve and Angle Blowing Valve.

Fig. 6561/6571. Duplex unit consisting of Angle Sealing Valve and Y Blowing Valve.

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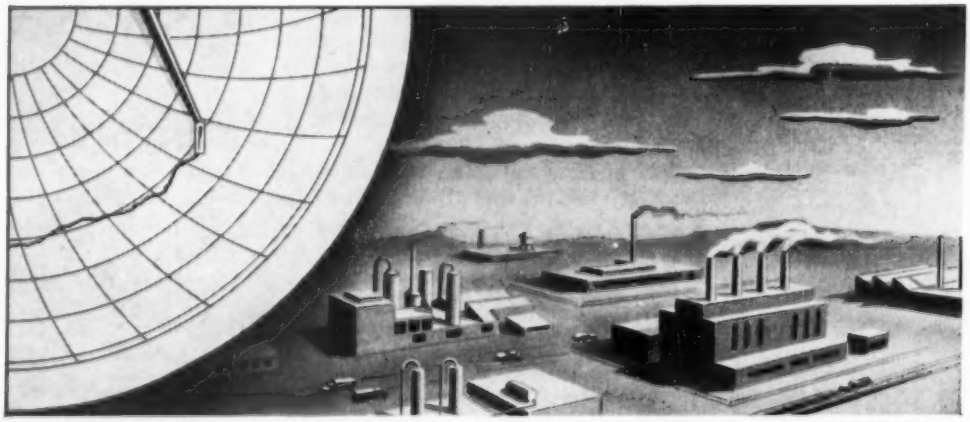

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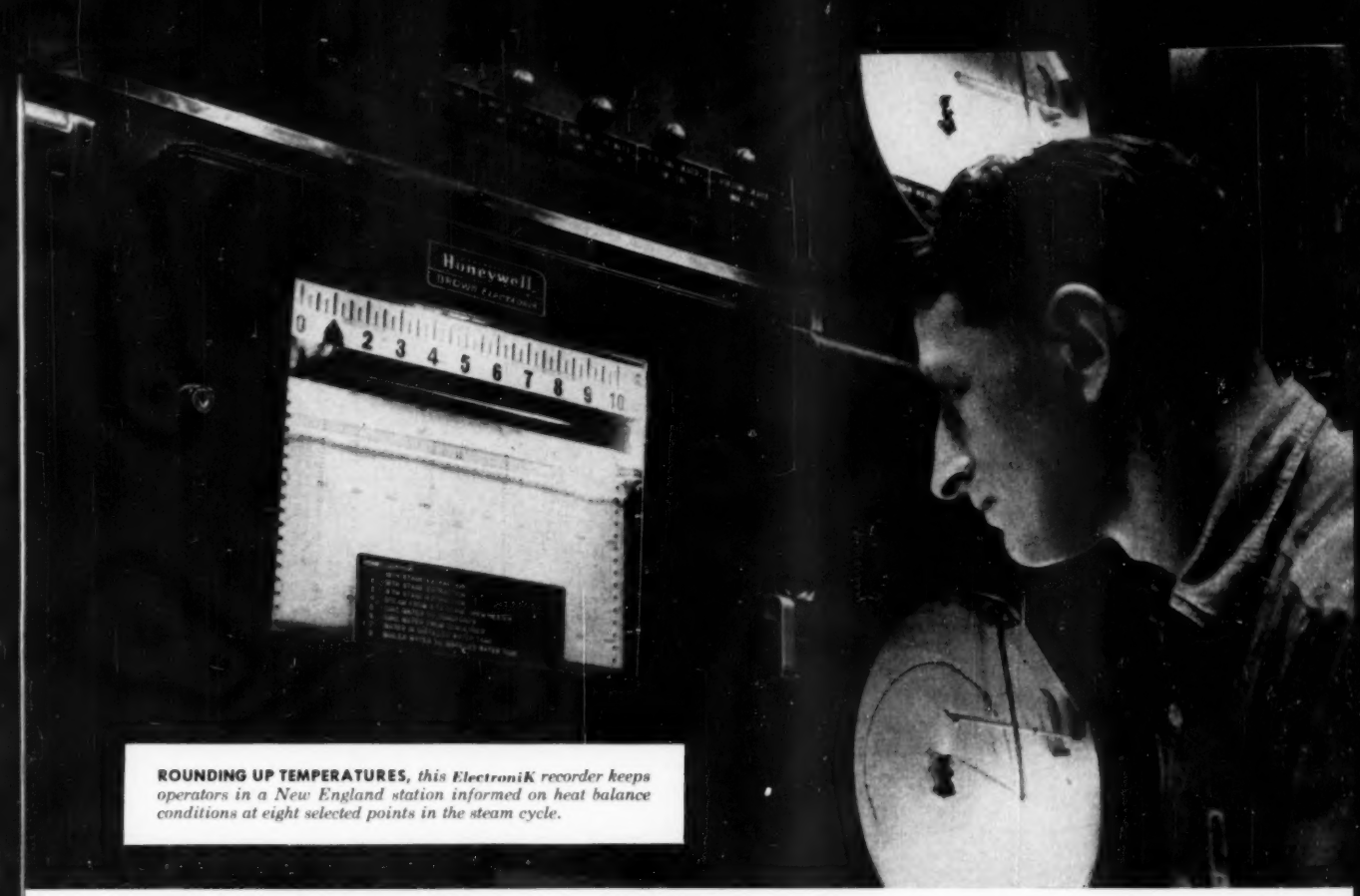

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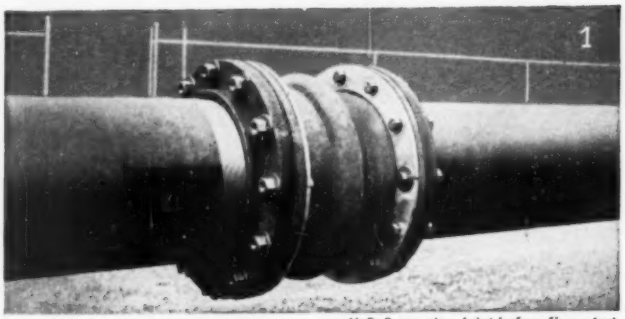
What's U. S. Rubber doing with expansion joints?

Making them flame-resistant, among other things. The U. S. Asbeston Expansion Joint originated by "U. S." is invaluable where fire is a hazard, and failure would shut down plant operations. Recommended for hot, dry gases (not steam) up to 300°F intermittently. The U.S. Asbeston, as well as the regular line of U.S. Rubber Expansion Joints, is used in pipe lines and mechanical equipment to absorb excess stresses due to expansion and contraction, to insulate against vibration, and to prevent the transmission of undesirable sound. These joints are also built to take care of misalignment, and are furnished either for pressure, or vacuum or both conditions: also specially made for fire safety on shipboard.

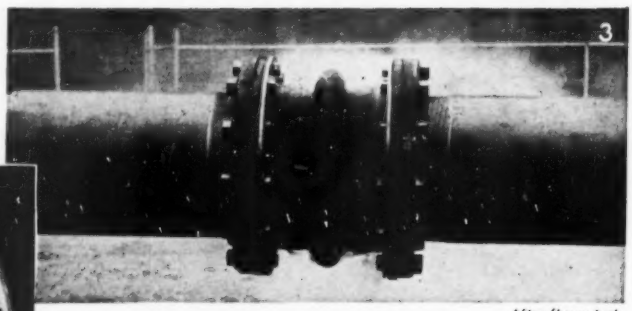
U. S. Rubber Expansion Joints eliminate many costly repairs, increase operating efficiency and extend the life of equipment. Because there are no moving parts to wear or bind, they give many years of service. Note in photos at right how an Asbeston test joint withstood a direct flame from fire built under it.

"U.S." has over 28 years' experience manufacturing expansion joints. Write to address below.



U. S. Expansion Joint before flame test.

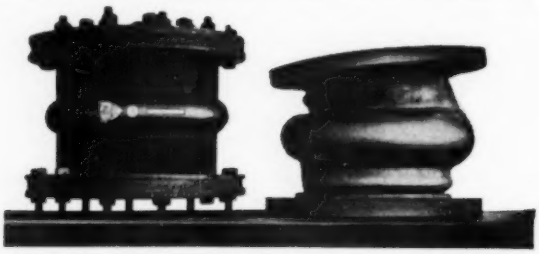
During flame test.



After flame test.

U. S. Asbeston® Expansion Joints are flame-resistant. They have been approved by government and industry.

One of two U.S. Rubber Expansion Joints used in condenser turbines of a power development plant in Oklahoma. The triple arch joint shown has inner diameter of 72" and the joints will compress 2½" to 3" and expand 1¼" to 1½".



In a test for shock, a metal joint and a U. S. Expansion Joint were filled with water and 463 lb. weight was dropped on each from a height of 10 feet. The metal joint (at right) collapsed at the first shock, while the U. S. Joint remained unaffected even after the test was stopped at 15 feet.

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HELPFUL BULLETINS

(*Continued from page 48*)

129 Universal Nipple Chuck — This single-sheet bulletin describes a nipple chuck for use with pipe machines, power drives or bench vises. Stresses extreme simplicity of the chuck, pictures its construction and use; includes sizes and prices. Beaver Pipe Tools, Inc.

HEATING

131 Unit Heater Ratings — Btu output ratings for various models of 30 makes of unit heaters are listed in 8-pp Bulletin 231. Tells how to figure condensing rates, how to select unit heater traps and gives hints on unit heater trapping. Includes tables for selecting traps for constant pressure and variable pressure operation, a table of constants for determining output of heaters at other than standard steam pressures and entering air temperatures, and chart for determining outputs at the various fan speeds. Armstrong Machine Works.

132 For Heating Liquids — Discussing submerged combustion as an improved means of heating corrosive or other liquids, this 6-pp booklet explains how the method saves fuel and corrosion losses, and tells where it can be profitably applied. Shows equipment used, explains how it operates. Submerged Combustion Co. of America Inc.

ENGINES

133 Smaller, Heavy-Duty Diesel — Form 10027 is a 12-pp catalog on company's TS diesel, a four-cycle engine in the 200 to 400 hp class. Provides drawings, installation views and diagrams to show why this diesel is called a smaller, lighter, but fully heavy-duty engine. Includes specifications, weights, performance curves. Ingersoll-Rand Co.

134 Four-Cycle Engines — Construction, operation and application features of company's 9- and 13-in. bore diesel dual-fuel and spark-fired gas engines are contained in Bulletin 205, 12 pp. Describes pressure lubrication, high velocity cooling, efficient fuel systems and other design characteristics. Schematic cross-section drawings in color show these features. Nordberg Mfg. Co.

COAL HANDLING

135 Coal Handling Technique — This bulletin presents company's Flo-Tubes as a modern way to handle coal. The new development utilizes the principle of a power-driven screw conveying material through a tube. Shows construction of this conveyor, pictures several coal-handling installations, lists other materials it can handle. Canton Stoker Corp.

136 Non-Segregating Coal Distribution — Form 73, 8 pp, explains the theory of company's Conical non-segregating coal distributor and shows how it prevents coal segregation. Provides photos of installations with many types of stokers, also photos of accessories for use with the distributor. Stock Equipment Co.

OTHER EQUIPMENT

137 Tubing for Many Jobs — Flexible tubing for ventilation, fume and dust removal and materials handling is described in 8-pp Catalog C2-4. Gives detailed information on company's Spiratube A and Spiratube R, two types of lightweight tubing made from continuous helical coils of spring wire wound with overlapping plies of fabric. Also covers a smaller-diameter tubing. Includes specifications, air friction charts, data on chemical resistance. Flexible Tubing Corp.

138 Surface Dehumidifier Units — Catalog 1660, 32 pp, giving the story on surface dehumidifiers, provides construction details and discussion on how surface cooling and evaporative cooling are put to work in the units. As a selection aid, a set of typical specifications is presented, also a procedure for determining size which gives formulae, psychometric and coil data necessary to the calculations. Catalog also gives installation data. Sturtevant Div., Westinghouse Electric Co.

139 Guide to Steel Selection — This bulletin covers in condensed form the characteristics, mechanical properties and uses of a comprehensive list of hot rolled and cold finished carbon and alloy steel bars. Compiled to make comparisons of the different types quick and easy, it serves as a convenient guide to choice of suitable qualities of bar steel for the job at hand. Joseph T. Ryerson & Son, Inc.

140 For Temperature-Humidity Testing — Bulletin TR covers test chambers for simulating temperatures from −100 to 200 F and relative humidities from 20 to 95 per cent. Gives data on heaters, humidification, de-humidification, controllers, compressor equipment, insulation, exterior construction and optional equipment. Tenney Engineering, Inc.

141 Condensers, Heaters, Coolers — Three new, all purpose smaller size condensers, heaters, coolers for chemicals, gases, solvents, acids, caustics, vapors, oil solutions as well as in refining, processing and blow down, are introduced in Bulletin 800. Units described are obtainable in a wide range of materials. Manning & Lewis Engineering Co.

142 Dehydration Equipment — The continuous removal of water vapor from air and other gases, to dew points as low as −100 F, is described in Bulletin SC-1013, 12 pp. Describes need for dehydration and extent to which gas or air can be dried, practicably. Three series of dehydrators are specified as to capacities and dimensions. Selas Corp. of America.

143 For Oil-Free Air — Featuring a large cutaway illustration Bulletin 600 presents manufacturer's new Oil-free air compressor for use where oil-free compressed air or gas is required. Tells what this compressor is designed to accomplish, discusses design elements. Pennsylvania Pump & Compressor Co.

144 Efficient Purchasing Procedures — Bulletin X-1202 20 pp, suggests time and money saving procedures for fast, precision purchase action. Provides a check list of important information needed for efficient operation. Effective methods for processing requisitions, procuring bids, placing orders and follow-up of purchase orders are outlined and actual case histories reviewed. Also shows forms designed to give better records in less time at lower net cost. Remington Rand Inc.

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FUEL OILS, LUBRICANTS

201 Cooperative Technical Consultation Service — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metalworking operations, processing, fuel oils, dust control. Gulf Oil Corp., Gulf Refining Co.

202 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, safety precautions. Cities Service Oil Co.

203 Lubrication of Diesel Engines — An excellent instruction manual, 50-pp Technical Bulletin B-1 (revised) also provides a brief history on diesel engines, an explanation of the fundamentals of design and the common types of diesels and their advantages. Explains combustion process, discusses modern fuel injection systems. Cylinder and bearing lubrication are treated and recommendations given for lubricating oils. Sun Oil Co.

204 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to their speed is also explained. Sinclair Refining Co.

205 Clean Oil for Diesels — A combination purifying and filtering unit utilizing centrifugal force and controlled filtration is the subject of illustrated Bulletin DL-1. Explains operation of the unit, tells advantages. Discusses importance of clean, dry lubricants. The De Laval Separator Co.

206 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, their uses and physical properties. Standard Oil Co. (Ind.)

207 Viscosity of Fluids — The larger significance of viscosity is discussed in Nos. 5 and 6, Vol. 36 of Lubrication, a technical publication. In six parts, the first illustrates simplest conception of streamline flow between two surfaces having relative motion. Part II covers streamline flow in capillary and other small tubes. Part III covers turbulent flow in pipes. Part IV discusses effects of temperature and pressure on viscosity, and Part V includes viscosity index. Part VI provides a brief reference to the nature of plastic flow. The Texas Co.

208 Turbine Oil Conditioning — Bulletin 832-P, 12 pp, offers a detailed explanation of the reasons for turbine oil conditioning, the way in which company's dry type conditioning equipment nullifies or prevents factors which promote deterioration of oil. Bowser, Inc.

PUMPS AND COMPRESSORS

209 Centrifugal Pump Handbooks — Two instruction booklets covering the installation, operation and repair of company's single-stage single-suction and multi-stage centrifugal pumps are available. Suggest regular inspection procedures and include pages for maintenance records. Also provide handy tables explaining how to locate trouble and listing causes and cures. Bulletin 08X7813, 24 pp, covers single-stage pumps; Bulletin 08X7780, 48 pp, covers the multi-stage pumps. State choice or both. Allis-Chalmers Mfg. Co.

210 Boiler Feed Pumps — Bulletin 109, 16 pp, illustrated in color, describes centrifugal pumps for boiler feed service. Pictures construction and major parts, floating seal incorporated. Capacity data, vapor pressure tables included. Pacific Pumps, Inc.

211 Rotary Pump Service Manual — The installation, operation and maintenance of rotary pumps are covered in 12-pp Service Manual 100-2. Subjects discussed include installing of foundation bolts, alignment, supporting vertical pumps, grouting, piping, suction lines, hot liquid pumps, rotation, packing, dismantling, reassembly, starting, operation and standing idle. Warren Steam Pump Co.

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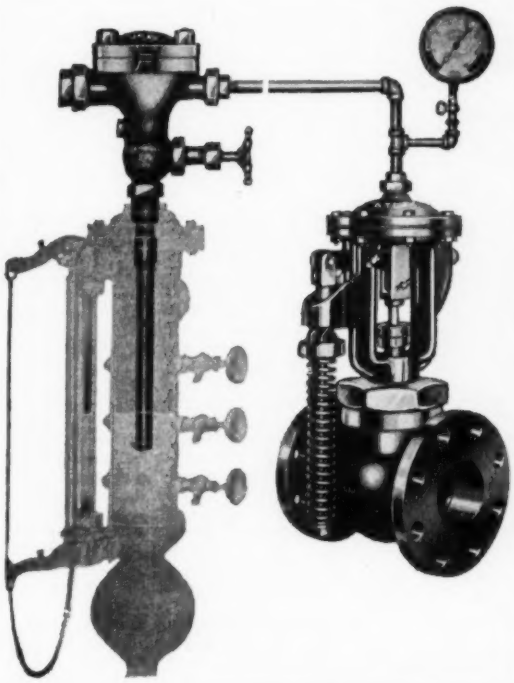

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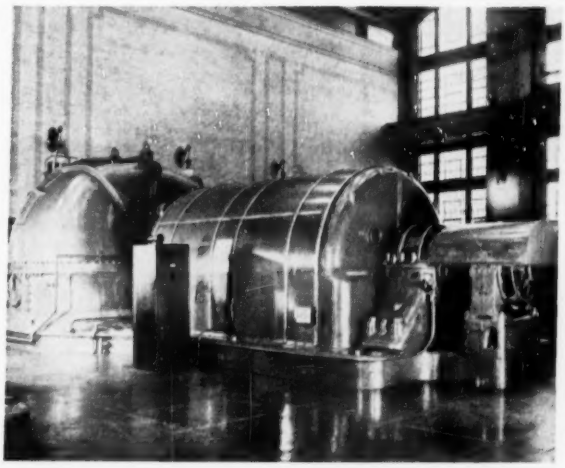

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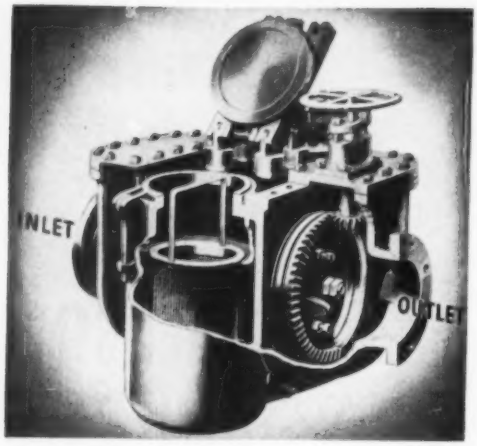

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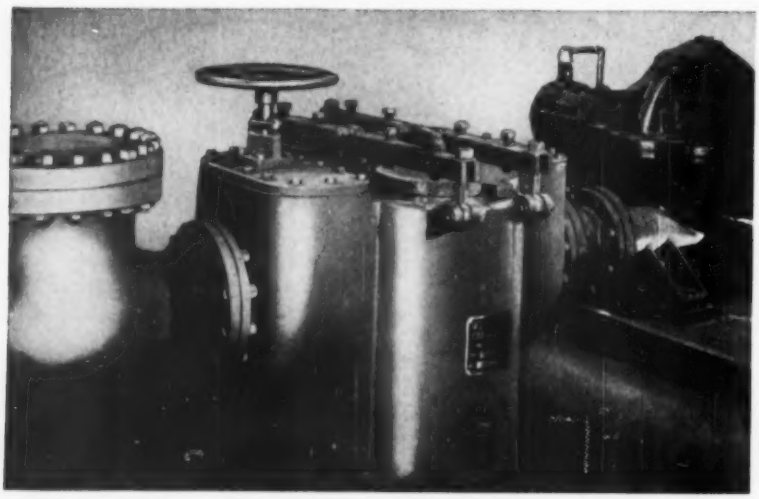

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212 Condensed Pump Data — Form 4383-J covers more than 20 types of general service pumps, rotary pumps, sump and drainage pumps, condensate units, self-priming units, stainless steel pumps and high pressure pumps. In easy-to-find tabular form, each model is pictured along with its characteristics, applications, features and references to specific literature providing further information. Lists selection factors. Goulds Pumps, Inc.

213 Controlled Volume Pumps — Bulletin 351, 16 pp, describes company's air-powered controlled volume pumps, designed to pump practically any liquid in measured volumes accurate to within a fraction of 1 per cent. Pumps are reciprocating, positive displacement plunger types. Cross-sectionals show design and operating details. Controls and typical automatic feed systems are discussed. Milton Roy Co.

214 Boiler Feed Pump — A barrel-type boiler feed pump for high pressure, high temperature service and designed to go on the line quickly without preliminary warm-up, is the subject of 12-pp Bulletin 1525. Fully illustrated text explains automatic operation of hydraulic thrust balance incorporated in this pump. De Laval Steam Turbine Co.

215 For Controlled Volume Pumping — Bulletin 300, 24 pp, describes Pulsafeeder piston-diaphragm pumps, stressing their no-stuffing box feature and noting that although basically a pump, this unit can do the work of a chemical feeder, a meter, an instrument, a filling machine, a proportioner and a sampler. Process Equipment Div. Lapp Insulator Co., Inc.

216 Compressor Selection Chart — Based on normal applications handling air with atmospheric intake pressure, this chart simplifies selection of proper size compressor, giving quick comparison between discharge pressure pounds per square inch gage and piston displacement cubic feet per minute. Worthington Corp.

COAL, ASH HANDLING

217 Spreader Stoker Data — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

218 Where Refuse Is Fuel — Presented in 24-pp Bulletin are installations of company's stokers with medium-size and larger units burning refuse fuels, separately or in combination with coal. Lists many of the refuse fuels handled successfully by this type of spreader stoker. Detroit Stoker Co.

219 Coal Scale — Bulletin 0250, 12 pp, describes a pressure-tight, automatic coal scale, its construction and operation. Shows how beam system, electrical components and linkages are protected from exposure to coal dust. Richardson Scale Co.

220 Economic Coal Storage — How tractors establish safe, orderly coal handling is told in this 8-pp booklet. Stresses flexibility, low operating costs. Also shows how tractors speed storage reclamation and how a tractor-scraper combination offers plus benefits. Illustrated

with action photos; picture several models. Tractor Div., Allis-Chalmers Mfg. Co.

221 Coal Handling Equipment — Modern equipment for the storage and handling of coal and ash is presented in 24-pp Bulletin 4300. Illustrated, covers concrete and tile silos, cylindrical steel tanks, suspended bunkers. Gifford-Wood Co.

222 Why Liquid Diffusion — What liquid diffusion can do for power plants is explained in Form B, which tells how liquid diffusion compounds work and gives four practical applications. These include dust control in coal handling, fly ash control, coal storage pile treatment and boiler cleaning. Johnson-March.

FUEL BURNERS

223 Gas Burners — Illustrated Bulletin 410-8, 16 pp, furnishes descriptive and technical data on company's gas burners and combination gas and oil burners, giving design details and explaining operation of each type. Coppus Engineering Corp.

224 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. Discusses steam and oil control valves. National Airoil Burner Co., Inc.

225 Oil Burning Equipment — Bulletin O-B, 37 contains 16 pp of technical information on company's oil and gas burning equipment, steam atomizing burners, mechanical atomizing burners, interchangeable burners, telling best applications, including capacity data. Also shows fuel oil pumping, heating systems. The Engineer Co.

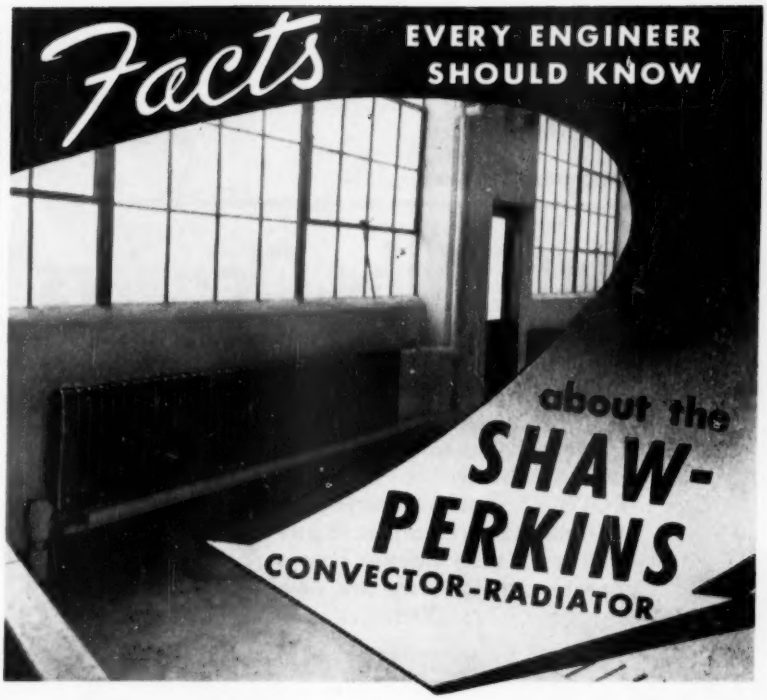
INSTRUMENTS AND CONTROLS

226 Electronic Control System — Bulletin A-701 introduces company's Autronic system, a miniature all-electronic system for controlling pressure, temperature, flow and level, intended for use in chemical processing plants, refineries, central stations, other applications where fast, accurate control is required. The Swartwout Co.

227 Instruments Control Systems — Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls and many others. Republic Flow Meters Co.

228 For Combining Control Signals — The improved design of company's Ratio Totalizer is described and pictured in color in 8-pp Bulletin 5452. This simplified versatile mechanism is a pneumatically operated control for combining input control pressures and spring forces, and producing an output control pressure based on addition, subtraction, multiplication, division or other functions. Hagan Corp.

229 Meters and Control Systems — Integrated control systems and individual meters for these systems are shown in 12-pp Bulletin 15-H. Boiler, combustion and feedwater controls are



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- PRESSURE SAFE
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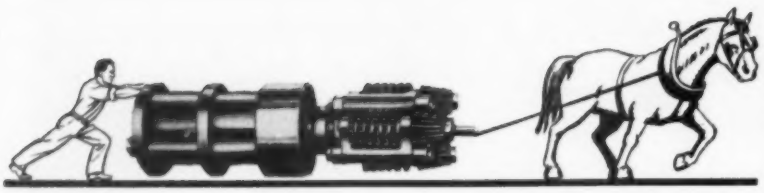

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singled out for special attention, complete with photographs and schematics. Also included are measurement requirements for steam temperature, condensate, boiler feed pump control. Bailey Meter Co.

230 Supervisory Instruments — Catalog 90-2, "Supervisory Instruments for Power Generation," consists of 41 pp on the instrumentation involved in generating stations. Separate sections cover steam generation instrumentation, turbine and generator instrumentation, electrical distribution instrumentation and diesel engine instrumentation. Measurement of temperature, pressure, flow, power generation and other variables discussed. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

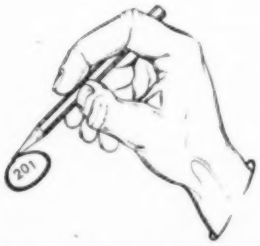
231 For Practical Men — This 24-pp pocket-size booklet presents insulation testing in simple language. Packed with maintenance hints, explains electrical insulation, tells how it can be tested and what makes it go bad. It describes the Megger insulation tester and justifies its cost in long run economy. James G. Biddle Co.

232 Industrial Thermometers — Catalog 125, 28 pp, presents ordering data on a wide range of industrial thermometers, giving scale ranges, dimensions and prices. Features company's Adjust-Angle thermometer designed for use at any angle front to back, left or right, through a 180 deg arc. Gives construction details and advantages of this adjustable-stem type instrument. Weksler Thermometer Corp.

233 Temperature Regulators — Twelve-pp Bulletin T, Catalog 80, describes manufacturer's line of regulators for controlling temperature of liquids and gases, giving their applications, operating characteristics, construction specifications, dimensions. Foster Engineering Co.

234 Pressure Regulator — Bulletin 1-B, 8-pp discusses design, operation and applications of a super-sensitive pressure regulator; shows typical installations. Also covers a compound regulator for controlling back pressure relief valve. Atlas Valve Co.

235 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co.



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236 **Sight Glass Flow Indicators** — Twelve-pp Bulletin 18-W, on company's line of flow indicators, shows how these mechanical devices indicate fluid flow and its direction in pipelines which can be directly observed through a sight glass and are suitable for service with liquid, gas, vapor, slurry or sludge sufficiently translucent to permit observation of indicating element. Schutte and Koerting Co.

ELECTRICAL

237 **Electrical Maintenance Tips** — Booklet B-5477, 28 pp, gives a complete outline of preventive electrical maintenance. Discusses general maintenance programs designed to reduce shutdown time and treats in detail the maintenance of power equipment. A suggested schedule of work and cleaning on power equipment is presented in chart form. Essential information on preventive maintenance for turbines, generators, switchboards, motors, controls is provided. Westinghouse Electric Corp.

238 **Wire, Cable Ordering Guide** — Newly-released General Catalog W-52-3, 186 pp, presents more than 500 different types of wires and cables. Contains comprehensive data on construction and operating characteristics for control and signal cables, cables for construction work, telephone wire and cables, and portable cords. A detailed technical engineering data section is also included. United States Rubber Co.

WATER CONDITIONING

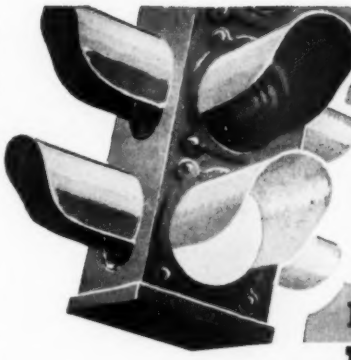
239 **Chlorination for Power Plants** — Form RA-2061-C is a 20-pp technical article, "Recent Developments in Chlorination and Equipment for Power Plants." Discusses such subjects as industrial water chlorination, the desliming processes, air pilot chlorinator operation, organic slimes and scales, chlorine ammonia reactions, chlorine residual recording. Wallace & Tiernan Products, Inc.

240 **Water Treatment** — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pre-treatment, internal treatment, treatment application, blowdown adjustment, test control. Describes equipment. Dearborn Chemical Co.

241 **Carryover Prevention** — Eight-pp Technical Paper 115 discusses the role of anti-foam agents in the prevention of carryover of boiler water solids with steam. Covers mechanical and chemical influences on carryover, foaming and anti-foam action, types of anti-foam agents. W. H. & L. D. Betz.

242 **Water Conditioning Data Book** — Recently revised, this pocket-size 116-pp booklet presents a compilation of 77 tables, all valuable to the power engineer. Covers such subjects as hydraulics, impurities in water, boiler feedwater make-up requirements, chemical conversions and chemical reactions. Contains excellent reference information on many phases and methods of water treatment. Available without charge to qualified power engineers. The Permutit Co.

243 **What's New on Ion Exchangers** — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nel-



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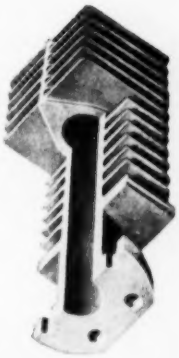

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That the availability for service of your boiler feed pump and the cost of maintaining it in top condition is determined by design . . . workmanship and materials of construction.

IT'S A MATTER OF RECORD

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Pacific Boiler Feed Pumps are fabricated from materials carefully selected for specific functions . . . steel forgings for structural strength and stability . . . alloy steels for hardness . . . resistence to wear and to corrosion-erosion.

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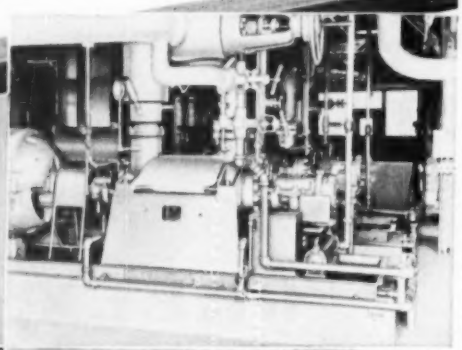

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colite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp, Super Nalcolite. State those wanted. National Aluminate Corp.

244 Modern pH and Chlorine Control — This 100-pp booklet gives details on color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; treating boiler feed water. W. A. Taylor & Co.

245 One-Minute Water Tests — Rapid, simple and accurate tests for determining water hardness are described in Bulletin 1RE50. Procedures, reagents, and equipment are described. Hall Laboratories, Inc.

246 Boiler Water Manual — Factual information on methods of applying chemicals in treatment of water for boilers is presented in 16-pp Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate and flow responsive feeding direct to boiler drum and to feed-water system, condensate returns, % Proportioneers, Inc. %

247 Feedwater Treating — Bulletin 1855, 30 pp, features manufacturer's hot process Accelerator for treatment of boiler feedwater, illustrating and explaining its operation and advantages, also optional equipment. Contains excellent discussion of necessity for treatment of makeup water, selection of proper equipment. Also covers limitations of hot process softening. Infilco Inc.

248 For Scale and Corrosion Control — Eleven of company's organic glucoside derivatives are described as to general properties and specific applications in this new bulletin. The various glucosates are now sold in drums ready for use. D. W. Haering & Co., Inc.

249 New Data on Zeolite Softeners — Publication 4520-A is a recently revised edition of company's booklet on zeolite water softening. Provides a glossary of terms used in the process, data for laying out a zeolite softening plant, factors governing size of equipment, selection of zeolite materials and discussion of the four stages of operation of a sodium zeolite softener. Cochrane Corp.

250 Water Conditioning Bulletin — This is an 8-pp discussion of water and the chemicals developed for conditioning it to control scale and algae and inhibit corrosion. Describes several chemicals in detail, giving properties, composition. Wright Chemical Corp.

251 Feedwater Treatment — Here is a 10-pp illustrated report on boiler feedwater treatment for a high-pressure, high-makeup power and steam

producing plant. It is based on studies to determine best method of meeting requirements for both the high-pressure steam used in power generating turbines and the district heating steam for downtown Philadelphia. Reasons for deciding on a demineralizing plant are given. Graver Water Conditioning Co.

BOILERS, GENERATORS

252 **Shop-Assembled Boiler** — Sixteen-pp Bulletin G-76, completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. Savings in erection, installation and moving costs are stressed along with wide range of applications. Capacities, dimensions and weights are given along with efficiency data. The Babcock & Wilcox Co.

253 **Re-circulation Steam Generator** — Here's a 6-pp folder on a controlled re-circulation steam generator, describing its development and uses, such as applications where steam is required in remote locations, where demands are intermittent, or load fluctuating. Combustion Engineering-Superheater, Inc.

VALVES, TRAPS, PIPING AND ACCESSORIES

254 **Check Valves** — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

255 **Gate Valves** — Literature is available on cast steel outside-stem-and-yoke gate valves; also on bronze, iron, steel and corrosion-resisting valves in a variety of types. The Wm. Powell Co.

256 **To Get at Those Valves** — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all sizes of valve wheels. Babbitt Steam Specialty Co.

257 **General Service Valves** — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co.

258 **High Pressure Gate Valve** — Described in 4-pp Form DH-273 is a forged steel gate valve designed for long service and low cost maintenance. Working pressures, sizes and prices listed. R-P & C Valve Div., American Chain & Cable Co., Inc.

259 **Valve Specialties** — Included in 90-pp Catalog A-50 is ordering and engineering information on automatic pressure flow and liquid level controls for steam, air, gas water, oil, other fluids. Sections are devoted to pressure regulators, altitude valve, pump governors and strainers; lever, float and motor operated valves; pilot valves; back pressure, relief and non-return valves, stream trap and air vent; liquid level controllers; solenoid valves. Davis Regulator Co.

260 **Air Release Valves** — Bulletin 1200, 8 pp, presents air release valves for water, sewage and industrial use.

Neoprene Tube Lining Used in New Method of Condenser Protection

Painter sprays a coating of Synco No. 1460 Neoprene, a synthetic rubber, into the tube inlets of the No. 1 condenser at a Midwestern Plant. Resilient coating was applied as a new and novel method of condenser tube protection.

On a baseball diamond, a pitched ball thrown with enough force to fracture a batter's skull if it gets in the way, will smack into the catcher's resilient mitt without injury to the catcher or the mitt.

This same principle is being applied by the Synco Corporation to condenser tubes and tube sheets, by applying a soft resilient synthetic rubber coating to the tube sheets and tube ends, which absorbs the shock of the fine suspended solids in the circulating water. In stopping the abrasive effect upon the tube sheet and the injection end of the tubes, much the same way a baseball mitt absorbs the energy of a pitched ball, the coating provides the cushion against the abrasive materials which actually grinds away the metal.

During a recent overhaul of their No. 1 Condenser of a large Midwestern Utility, it was found the condenser tubes were seriously eroded at the inlet end, caused by the abrasive materials carried by the circulating water. It was realized that the condenser could not be expected to operate for any great period of time without serious tube failures and that some remedy was necessary.

After extensive investigation it was decided that a coating of neoprene base rubber compound, applied to the tube sheets and the inlet ends of the condenser tubes would solve the problem and thus avoid a costly replacement job and avoid excessive unit outage time. Arrangement was made with the Synco Corporation of Emmaus, Pa. to supply the materials and supervise the work. This solution to this utility's condenser problem, not only effectively prolonged the useful life of the condenser tubes, required a minimum outage time and cost but a small fraction of a retubing job, saving critical materials.

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Explains essential requirements for this type of valve; illustrates methods of installation. A large cutaway drawing accompanies discussion of the operating and construction details. Standard high pressure and special types described, dimensions given. Simplex Valve & Meter Co.

261 **Iron Body Gate Valves** — Bulletin 805, 8 pp, covers iron body, bronze trim gate valves in both outside screw and yoke and non-rising stem types, telling applications for each. Design features are explained. Gives dimensions, working pressures, and prices. The Ohio Injector Co.

262 **Steam Trap Book** — Catalog J is the 44-pp new edition of this company's popular trap book and serves as a manual of trapping practice. Includes a catalog section giving physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section explaining trap installation, trouble-shooting and repair. Armstrong Machine Works.

263 **Steam Trap Reference Manual** — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure trap sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Also provided are installation and operating suggestions, prices. Yarnall-Waring Co.

264 **Steam, Air and Gasoline Traps** — Illustrated Catalog 751, 32 pp, provides capacity tables, installation diagrams and a section containing data, charts and formulas for determining proper size trap for specific applications. Covers thermostatic steam traps for pressures to 225 lb, expansion steam traps, weight-operated traps for steam, air and gasoline as well as piston-operated steam traps. W. H. Nicholson & Co.

265 **Piping Pointers** — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8 pp valve selection guide. Crane Co.

266 **Duplex Strainer** — This literature describes company's Duplex strainer with single handwheel control. Shows how it is designed with only one stuffing box and can be cleaned under full flow. R. S. Products Corp.

267 **Valves, Fittings and Flanges** — Catalog F-9 is a 400-pp, permanently bound reference book on drop forged steel valves, fittings and flanges for practically all piping needs at high and low pressures and temperatures. Provides ordering information on company's complete line, also much helpful engineering and application data; includes a section on products for refrigeration service. Available to qualified power engineers; please give your title. Henry Vogt Machine Co.

268 **Flanges for Severe Service** — This 4-pp bulletin describes a flange specially developed for services involving severe abrasion and corrosives, and for suction and discharge service. Goodall Rubber Co.

269 **Unions and Fittings** — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. Dart Union Co.

COOLING

270 **Cooling Towers** — Bulletin AQ-50 is on packaged water cooling towers in 3 to 50 t sizes. Gives specifications for the tower and discusses special features. Also provides dimensional and application data. The Marley Co., Inc.

271 **Heat Exchanger** — Bulletin 114, a small folder, gives concise information on company's Aero heat exchanger with balanced wet bulb control designed to cool engines or process equipment, coolants and lubricants, liquids and gases for processing operations. Niagara Blower Co.

PACKINGS, GASKETS, SEALS

272 **Packings and Gaskets** — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for a wide variety of applications. Packing Div., Raybestos-Manhattan, Inc.

273 **Seals for Bearings** — Complete information on manufacturer's Klozure oil and grease seals for bearings is

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available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical applications and lists sizes and part numbers. Also describes mechanical pressure seals for rotary shafts. The Garlock Packing Co.

274 To Pack Against Acid — A packing that is chemically resistant to all acids, alkalies and caustics is described in this literature. Tells how packing incorporates both asbestos and Teflon in its construction, stresses advantages. A. W. Chesterton Co.

OTHER EQUIPMENT

275 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, steam generators. Discusses heat transfer properties, high temperature use. Bridgeport Brass Co.

276 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads, discussing special features. Roto Div., Elliott Co.

277 Turbine Generators — Bulletin H-18, 40 pp, covers turbine-generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings showing a typical installation arrangement. Elliott Co.

278 Simplified Radiation Heating — Convector radiators designed for connection directly into process steam lines and for operation at pressures up to 150 psi are described in this bulletin. Explains how heat emission rate increases with pressure, and stresses high heat out put, good drainage, low surface temperature. Shaw-Perkins Mfg. Co.

279 Mechanical Draft Fans — Mechanical draft fans for both forced and induced draft service are described in 20-pp Bulletin 168. Illustrated with drawings of typical fan types and photos of installations, includes performance curves showing efficiencies of various types of fans. The Green Fuel Economizer Co., Inc.

280 Dowtherm Vaporizer — Bulletin No. 48-2, describing manufacturer's Type "A" Dowtherm Vaporizer, tells how this unit is designed to evaporate Dowtherm to provide dependable operation at maximum temperatures. The Wickes Boiler Co.

281 Synthetic Coatings — Specially engineered coatings for use in pump rehabilitation, condenser tube and sheet protection, valves, concrete, steel and transite piping, and condenser sealing are discussed in illustrated bulletin. Also describes an acid-proof coating for cooling tower structures. Synco Corp.

282 Water Heaters — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-, four- and six-pass designs, removable tube bundles. Davis Engineering Corp.

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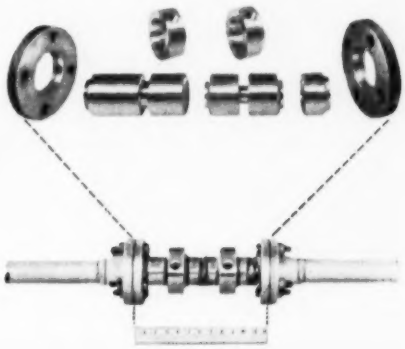

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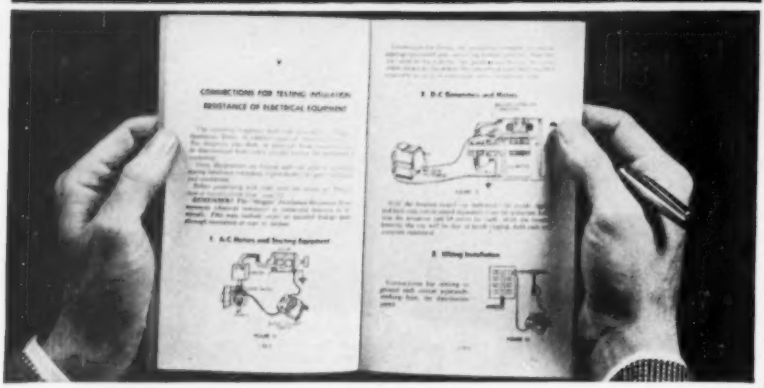

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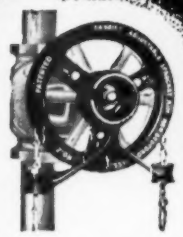

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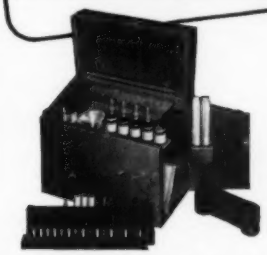

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for Every Plant Use

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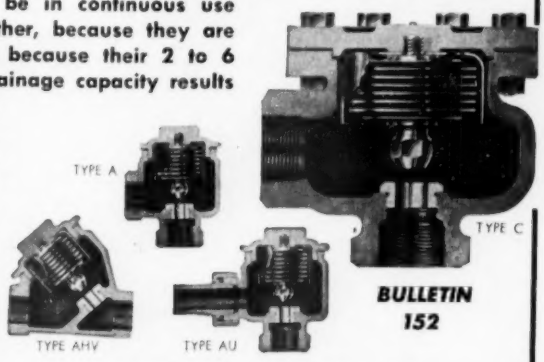

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The new DAVIS No. 14B diaphragm motor valve incorporates design features that give you better control with more dependability. Enclosed yoke, lubricated stuffing box and valve stem position indicator are features that make this valve easier to service and shows at a glance the position of the inner valve.

The No. 14B is ideal for pressure control or relief, or for back pressure service on steam, air, water, oil or gas. Features spring loaded, balanced type inner valve; direct or reverse action. The 14B is available in bronze, semi-steel or steel body . . . special trim available for corrosive services. Sizes range from ½ to 14". . . . Initial pressures to 1500 p.s.i. . . . Reduced pressures from 1000 to 1 p.s.i.

Look into the new 14B Regulator for better pressure control. When inquiring state service, size, pressure and temperature. Ask for full information.

Davis

DAVIS REGULATOR COMPANY

2508 S. WASHTENAW AVENUE CHICAGO 8, ILLINOIS

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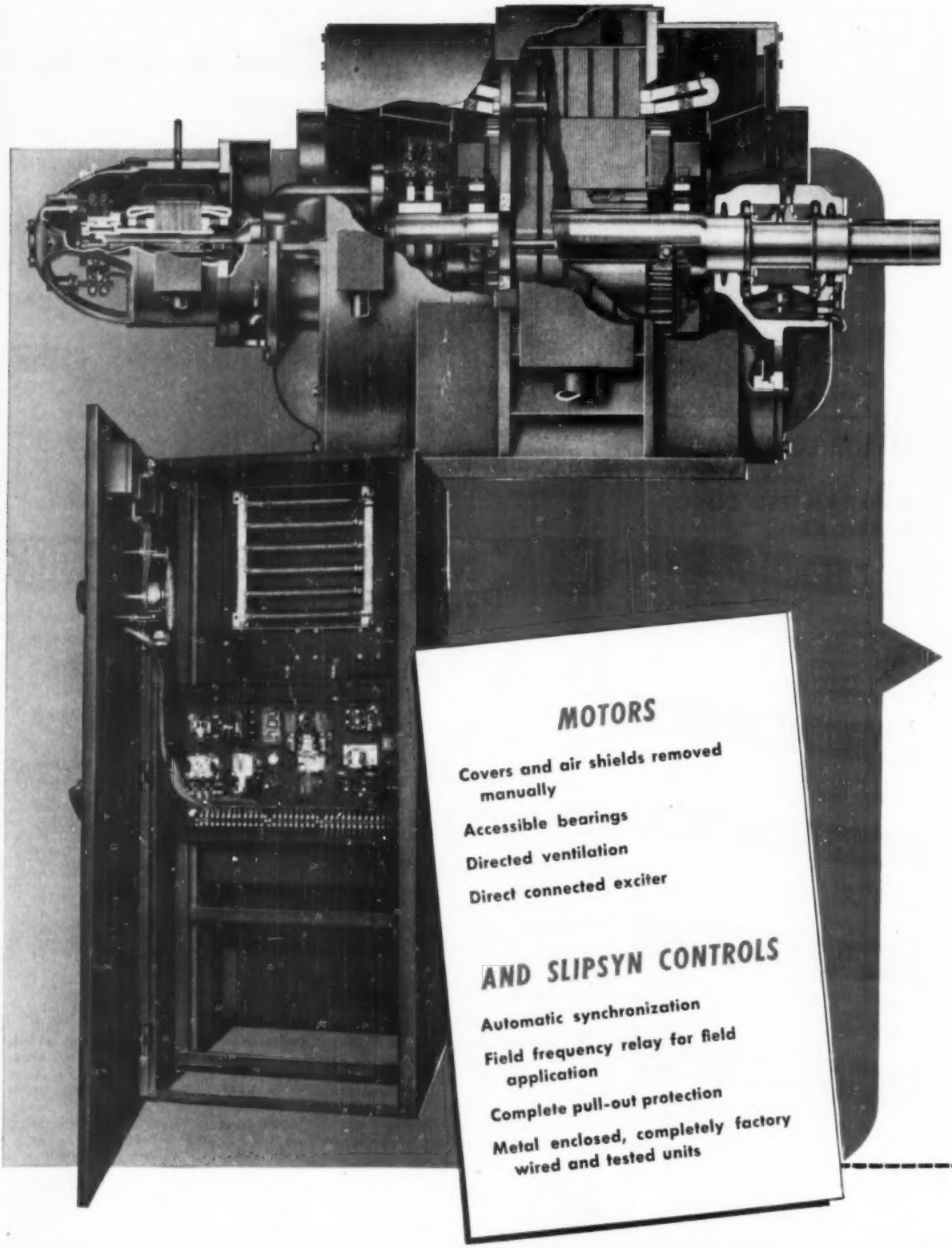

MOTORS

Covers and air shields removed manually

Accessible bearings

Directed ventilation

Direct connected exciter

AND SLIPSYN CONTROLS

Automatic synchronization

Field frequency relay for field application

Complete pull-out protection

Metal enclosed, completely factory wired and tested units

MORE POWER PER DOLLAR

with Westinghouse matched synchronous Motors and Controls

You can improve your power factor and save money on power bills with Westinghouse synchronous motors. You can save more by matching the control to the motor. That way you get a completely co-ordinated system that makes sure you get the full savings available.

HIGH MOTOR EFFICIENCY is inherent in synchronous motor design. Losses are lower than in induction motors. In many cases, the first cost is less. Considering first cost, low maintenance expense and improvement of power factor, the synchronous motor supplies more power per dollar for many types of drives than any other motor.

REDUCED MAINTENANCE COSTS are the result of exclusive inspection and servicing features. Readily accessible split-sleeve bearings can be removed by hand. There's no top half of bearing bracket to remove. Brushes are readily available through the front bracket for both inspection and maintenance.

CONTROL IMPROVES PERFORMANCE Getting the motor started right every time . . . providing complete protection at all times are the basic functions of the Slipsyn motor control. Heart of the system is the ASR polarized slip frequency relay. It not only applies the field at the proper speed, but also at favorable rotor position for best performance. Welded all-steel cabinets with sectionalized compartments protect personnel. All live parts are completely enclosed. Attractive cabinet blends with modern plant equipment.

MORE DATA? Get in touch with your local Westinghouse representative for complete details. Ask for copies of B-4379 "Slipsyn Control", and DB-3200. Or write direct to Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

J-10352

YOU CAN BE SURE.. IF IT'S

Westinghouse

WESTINGHOUSE

LARGE SYNCHRONOUS MOTORS AND CONTROLS

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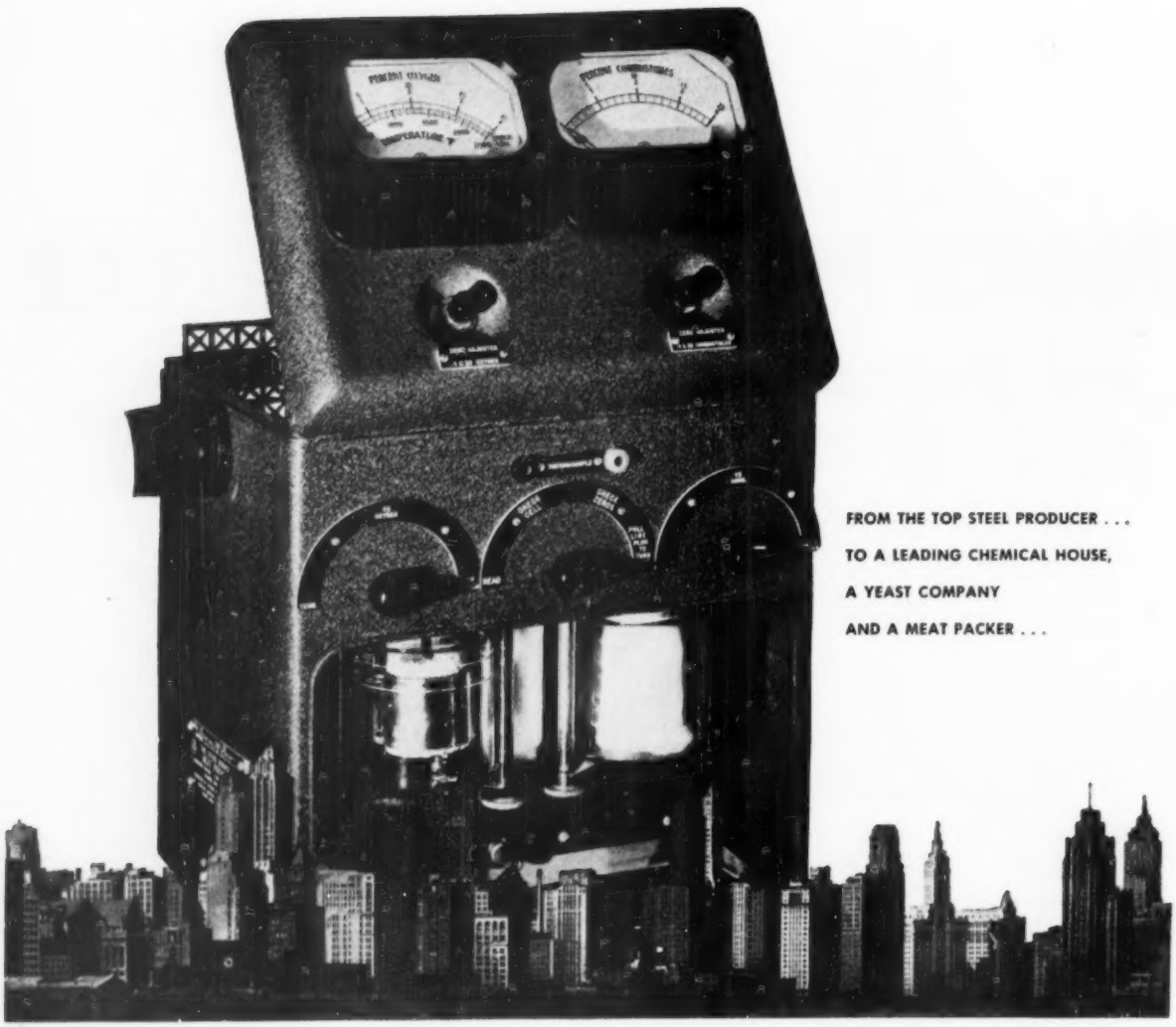

FROM THE TOP STEEL PRODUCER . . .
TO A LEADING CHEMICAL HOUSE,
A YEAST COMPANY
AND A MEAT PACKER . . .

Heat Prover SERVES 62 DIFFERENT COMPANIES IN THE GREAT CHICAGO INDUSTRIAL AREA!

The Cities Service Heat Prover is graphically proving its worth to all kinds of industry in the Chicago area and elsewhere throughout the country.

62 different companies, producing everything from steel to beef, have found the Heat Prover an important aid to increased production and big dollar economy.

WHEREVER A FURNACE OPERATION IS INVOLVED, Heat Prover can help increase productivity by providing:

1. **Rapid, continuous sampling.**
2. **Simultaneous reading of oxygen and combustibles.**
3. **Direct measurement of oxygen and combustibles.**
4. **Easy portability.**
5. **No maintenance; no re-calibration.**

REMEMBER: Heat Prover is not an instrument you buy but a service we supply. Contact the Cities Service office in your area and learn how Heat Prover can serve you . . . or write CITIES SERVICE OIL COMPANY, Dept. A23, Sixty Wall Tower, New York City 5.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

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TYPISTS

Male Help Wanted
Second Shift

FACTOR

LL TIME
Machine Operator

BOX - 2771-7

PRODUCTION ENGINEER

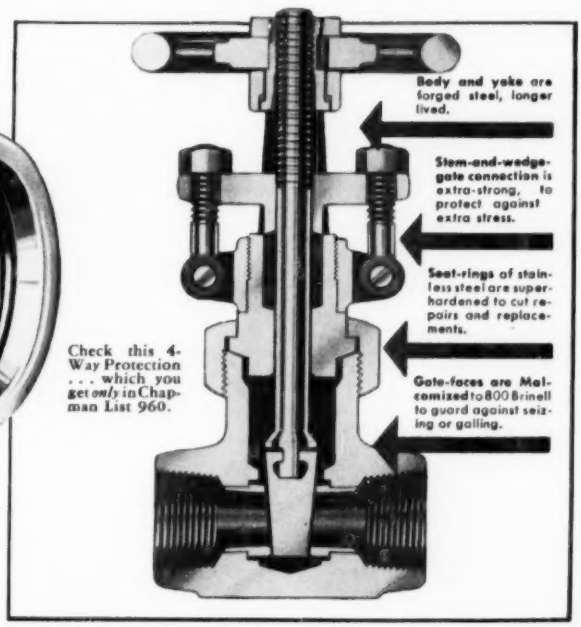
Name Your Job!

If it's for Small Forged Steel Gate Valves... then it's for

CHAPMAN LIST 960

Many different jobs . . . but on each one, List 960 gives you the same top standard of Chapman Valve performance. Check the 4 exclusive Chapman features below . . . and make this your *check list* in buying *all* forged steel gate valves from ½" to 2" inclusive.

Chapman List 960 is manufactured with rising stem, either with yoke as shown, or with inside screw . . . and with gasketed or metal-to-metal bonnet joints. Pressure range: 2,000 lb. at 100°F. to 380 lbs. at 1,000°F. For higher pressures, specify List 990. Have you a copy of Catalog No. 10? Write for it today.


Body and yoke are forged steel, longer lived.
Stem-and-wedge-gate connection is extra-strong, to protect against extra stress.
Seat-rings of stainless steel are superhardened to cut repairs and replacements.
Gate-faces are Malcomized to 800 Brinell to guard against seizing or galling.
Check this 4-Way Protection . . . which you get *only* in Chapman List 960.

The **CHAPMAN VALVE**
MANUFACTURING COMPANY
Indian Orchard, Mass.

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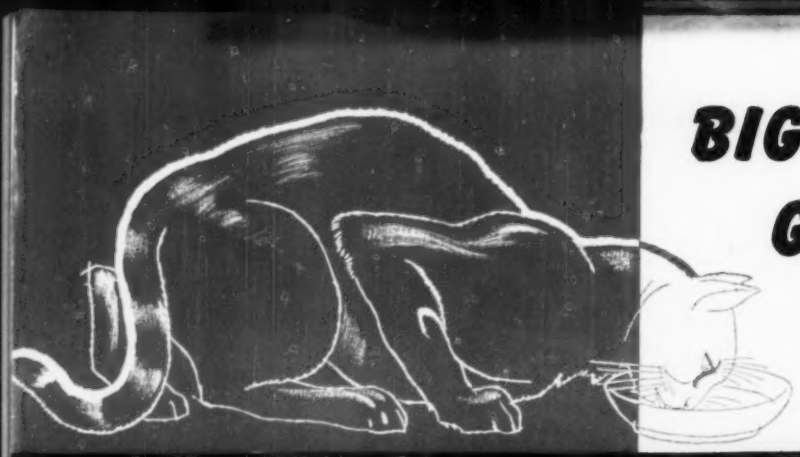
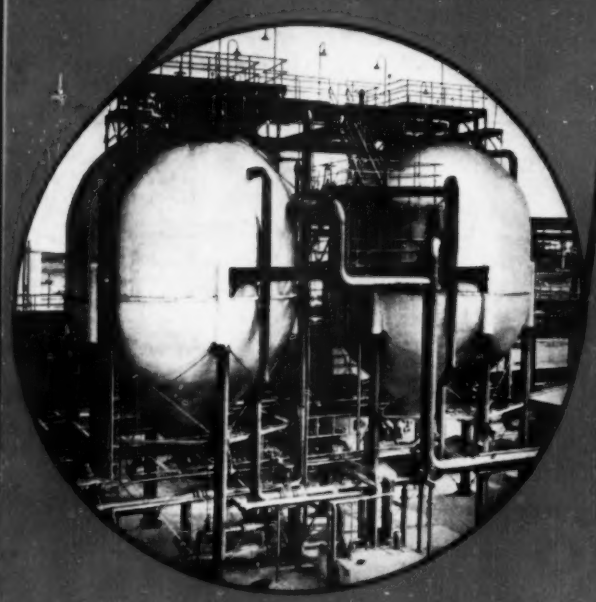
January, 1953



BIG "CATS" NEED GOOD WATER TOO . . .



Permutit two-stage hot lime soda and phosphate water softener recently installed at The Texas Company's Eagle Point Refinery.

WATER CONDITIONING HEADQUARTERS FOR 40 YEARS

—*and Permutit Equipment brings it, at lower cost, to The Texas Company's new Eagle Point "cat" crackers . . .*

The Texas Company, at their Eagle Point Works in Westville, N. J., processes 60,000 barrels of crude per day, in which processing modern fluid catalytic cracking is used. Over-all refinery steam and electric power balance dictated refinery boiler plant operation at 900 psi. Treated water is used on waste heat boilers on the cat cracker. They operate a Permutit two-stage hot lime soda and phosphate water softener to protect their boilers against scale and corrosion. Permutit equipment and its location are illustrated.

The Texas Company is but one of many concerns which realizes the value of proper water softening. To solve water conditioning problems, manufacturers in hundreds of industries have turned to Permutit. With 40 years of experience in water treatment, Permutit possesses the know-how to solve water conditioning problems economically at lower initial cost, with greater continuing savings.

For aid in the solution of your own water problems, write to The Permutit Company, Dept. PE1, 330 West 42nd Street, New York 36, N. Y. or to Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

PERMUTIT